TECHNOLOGY DEPT.

Gas Journal

VOL. 289. 109th YEAR. LONDON, MARCH 27, 1957. No. 4889 PRICE 1/6

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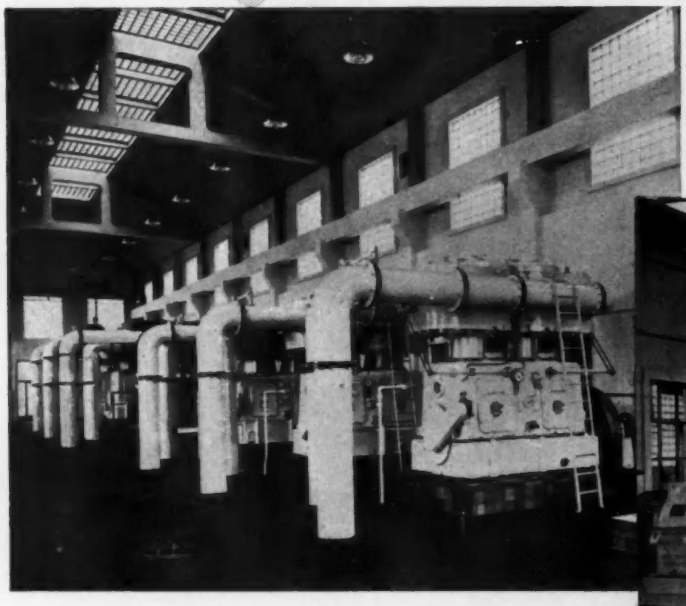

BASE YOUR DECISION ON APPLIED EXPERIENCE AND EFFICIENCY

Photographs by courtesy of N.W.G.B.

Illustrations show the interior of the Compressor House comprising:
3 – Gas Compressors – 22½" dia. x 12" stroke (2 variable speed and 1 constant speed), each capable of 160,000 cu. ft. per hour, running at 325 R.P.M. at 20 lbs. per sq. inch outlet pressure. 3 – 37" dia. x 14" stroke (2 variable speed and 1 constant speed), each capable of 500,000 cu. ft. per hour running at 290 R.P.M. at 10 lbs. per sq. inch outlet pressure. 1 – Future machine 26½" dia. x 12" stroke (constant speed), 250,000 cu. ft. per hour running at 325 R.P.M. at 10 lbs. per sq. inch outlet pressure.

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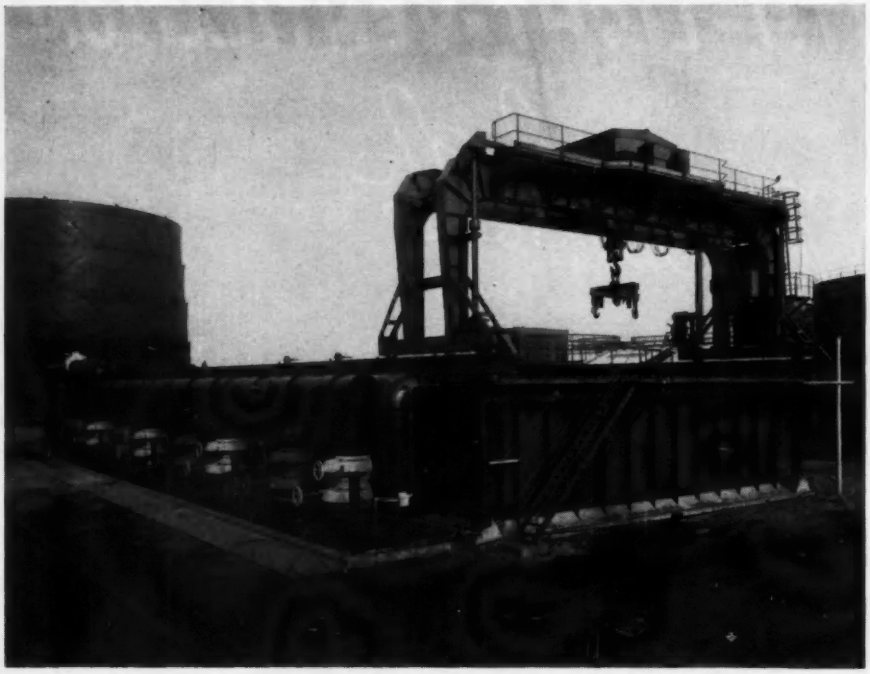

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The Illustration is by courtesy of the Southern Gas Board.)

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(Carr & Litler Patent No. 628338)

by DEMPSTERS of MANCHESTER

are economically designed and can be shown to save those oxide handling costs which have long been accepted as inevitable in dry box purification.

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We maintain a complete and well-balanced organisation for the design and construction of PLANT FOR THE GAS AND ALLIED INDUSTRIES, and can supply PURIFIERS of this and other types to suit your requirements.

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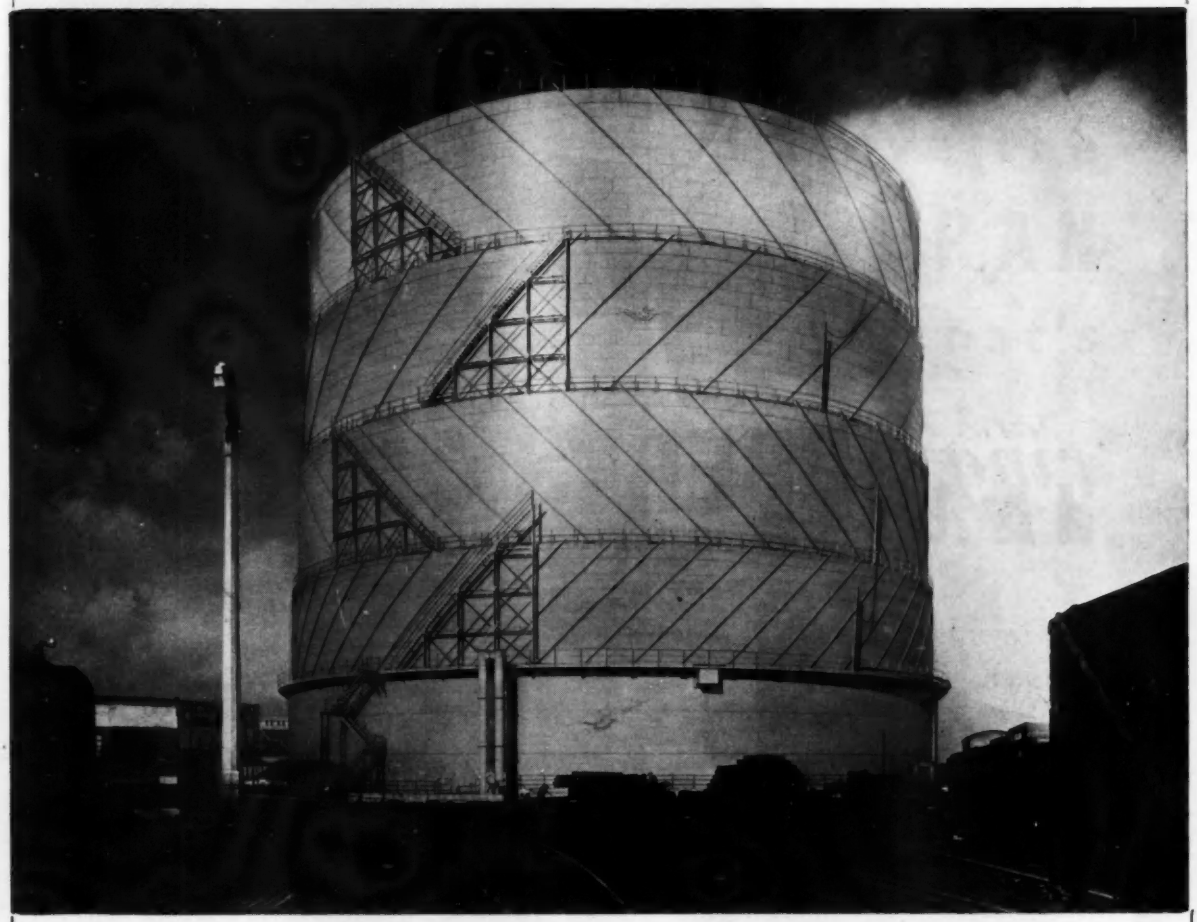

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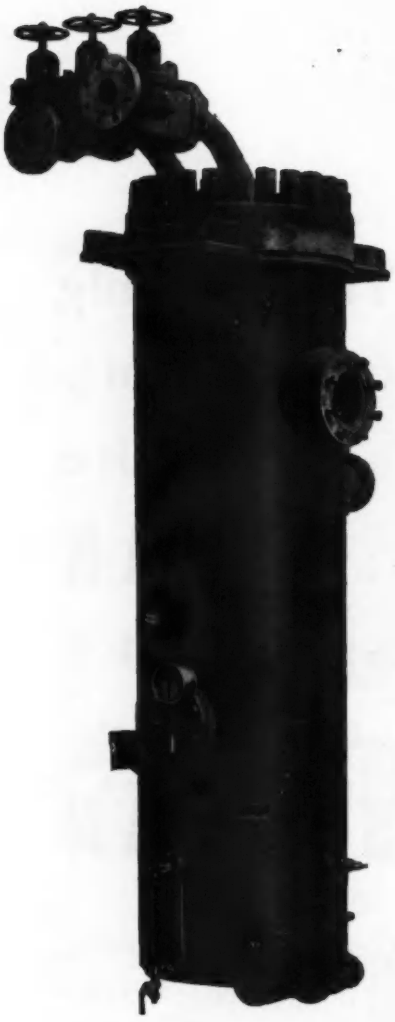

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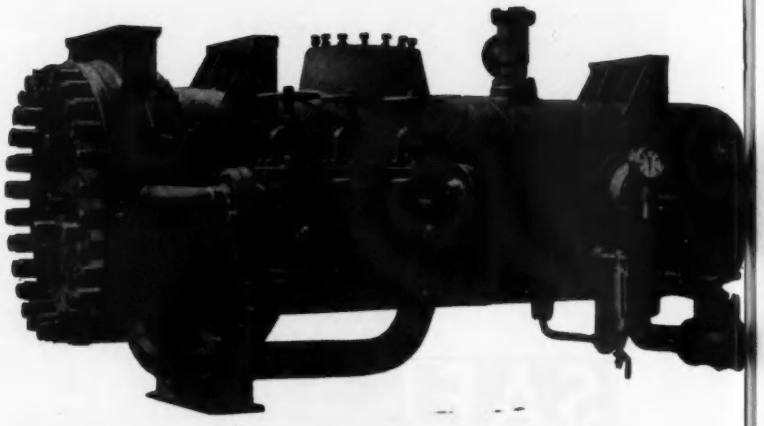

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Photograph by courtesy of National Coal Board

Photograph by courtesy of National Coal Board

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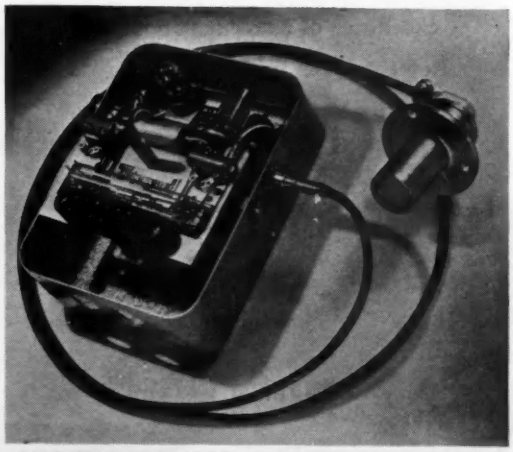

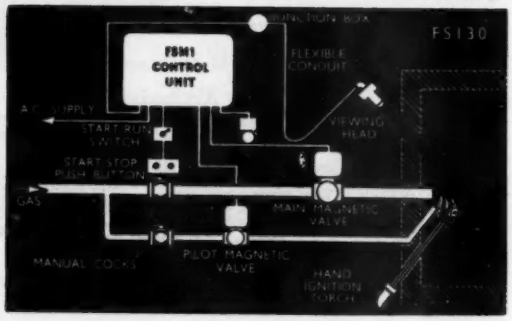

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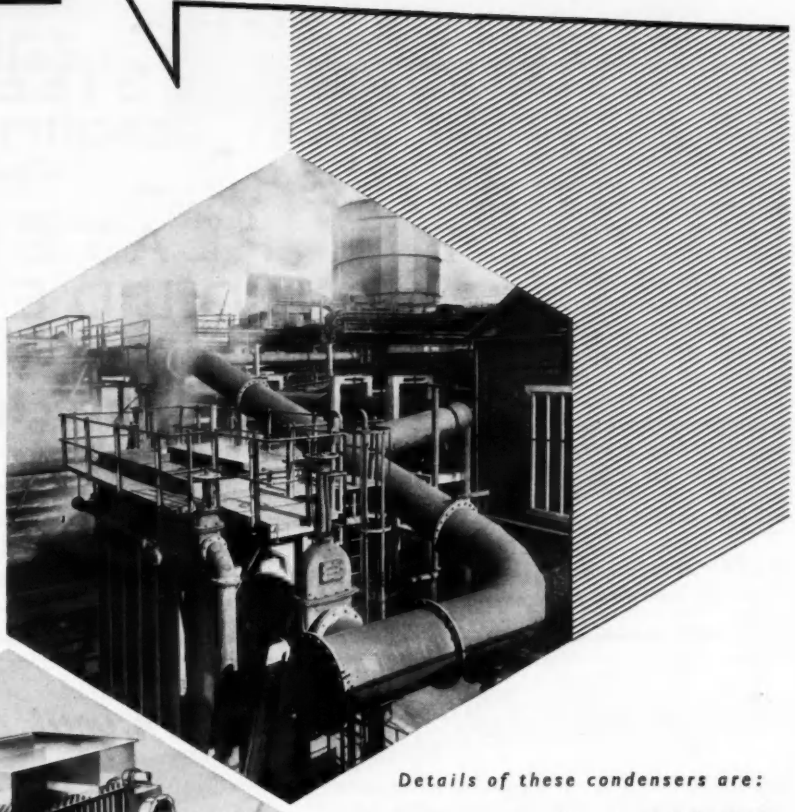

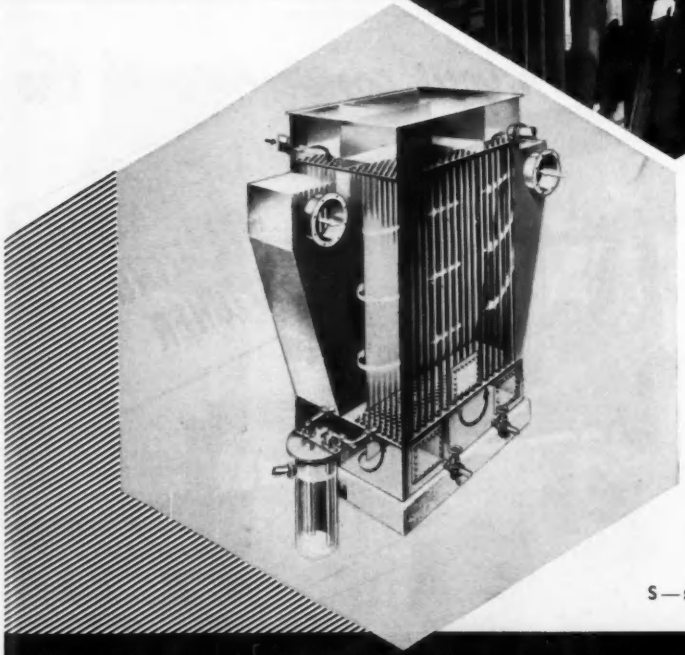

Details of these condensers are:

Customer and Location	No. Condensers	Total Capacity of Condensing Plant
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W. Midlands G.B., Redditch	2 (P)	3½ ,, ,, ,, *
Wales G.B., Aberavon	2 (S)	6½ ,, ,, ,, *
N. Western G.B., Linacre	2 (P)	8 ,, ,, ,, *
N. Western G.B., Bolton	2 (S)	8 ,, ,, ,,
Consett Iron Co., Consett	3 (P)	24 ,, ,, ,, †
S. Western G.B., Devonport	1	2½ ,, ,, ,, *
S. Eastern G.B., Gillingham	2 (S)	3 ,, ,, ,, *
E. Midlands G.B., Neepsend	2 (P)	5 ,, ,, ,,
Southern G.B., Oxford	2 (P)	12 ,, ,, ,,

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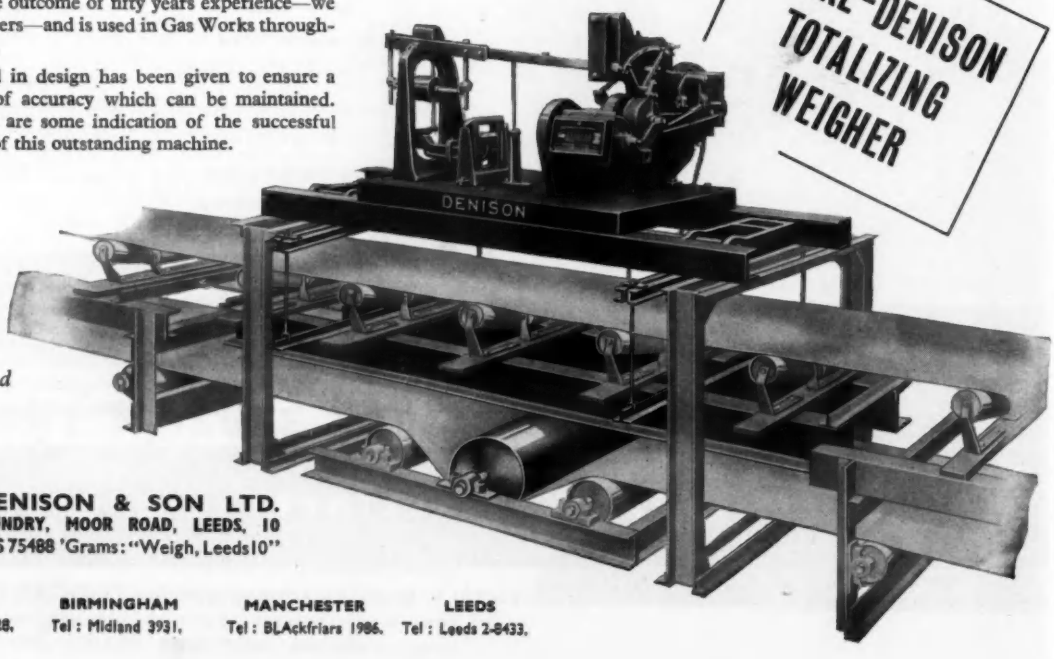

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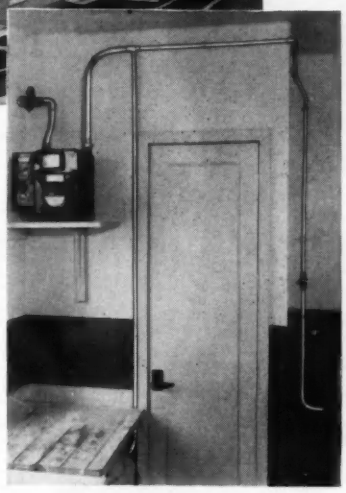

are used for the gas carcassing in the "Miller" Houses, Burgh of Barrhead.

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for the gas industry

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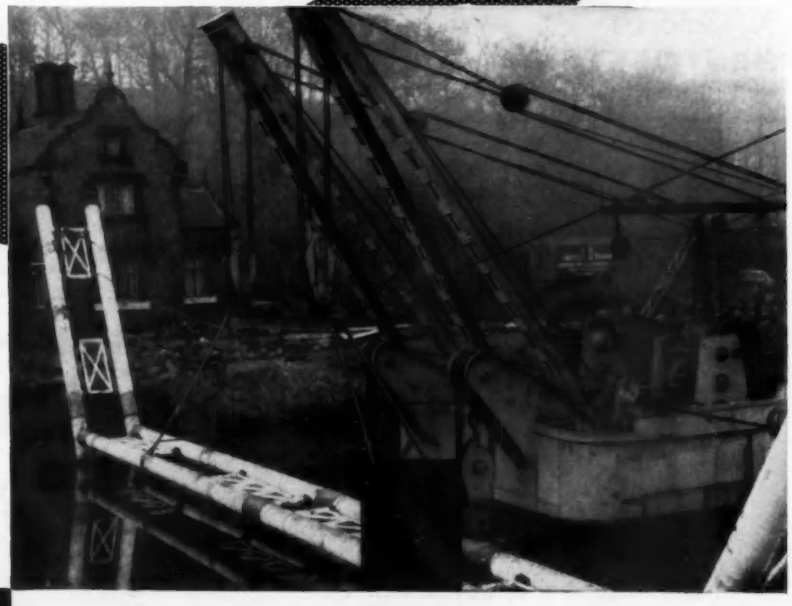

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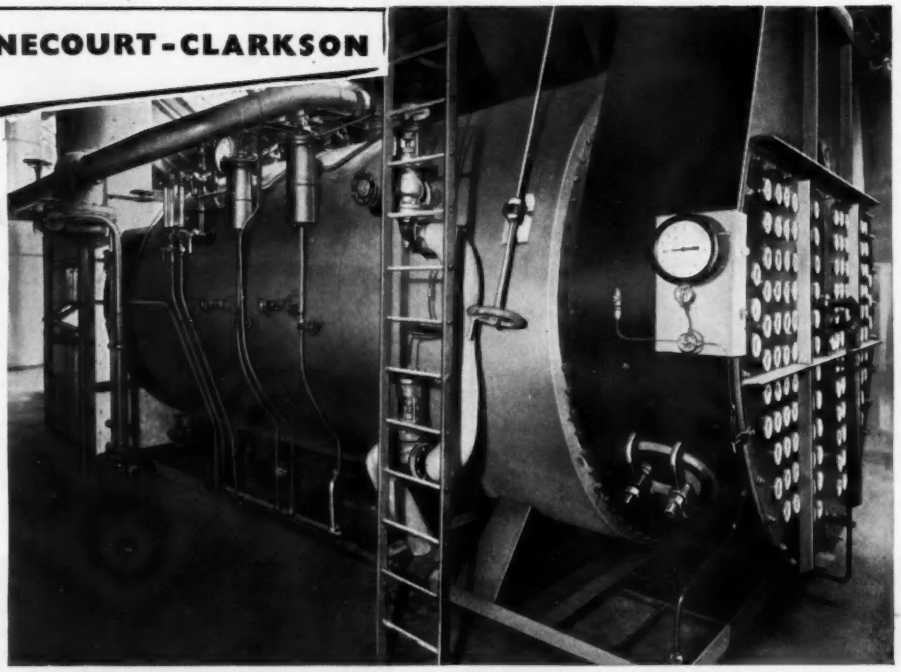

The illustration shows one of the Spencer-Bonecourt waste-heat boilers at Stoke-on-Trent Gas Works. Similar units are installed on all the Glover-West Continuous Vertical carbonising plant in this works.

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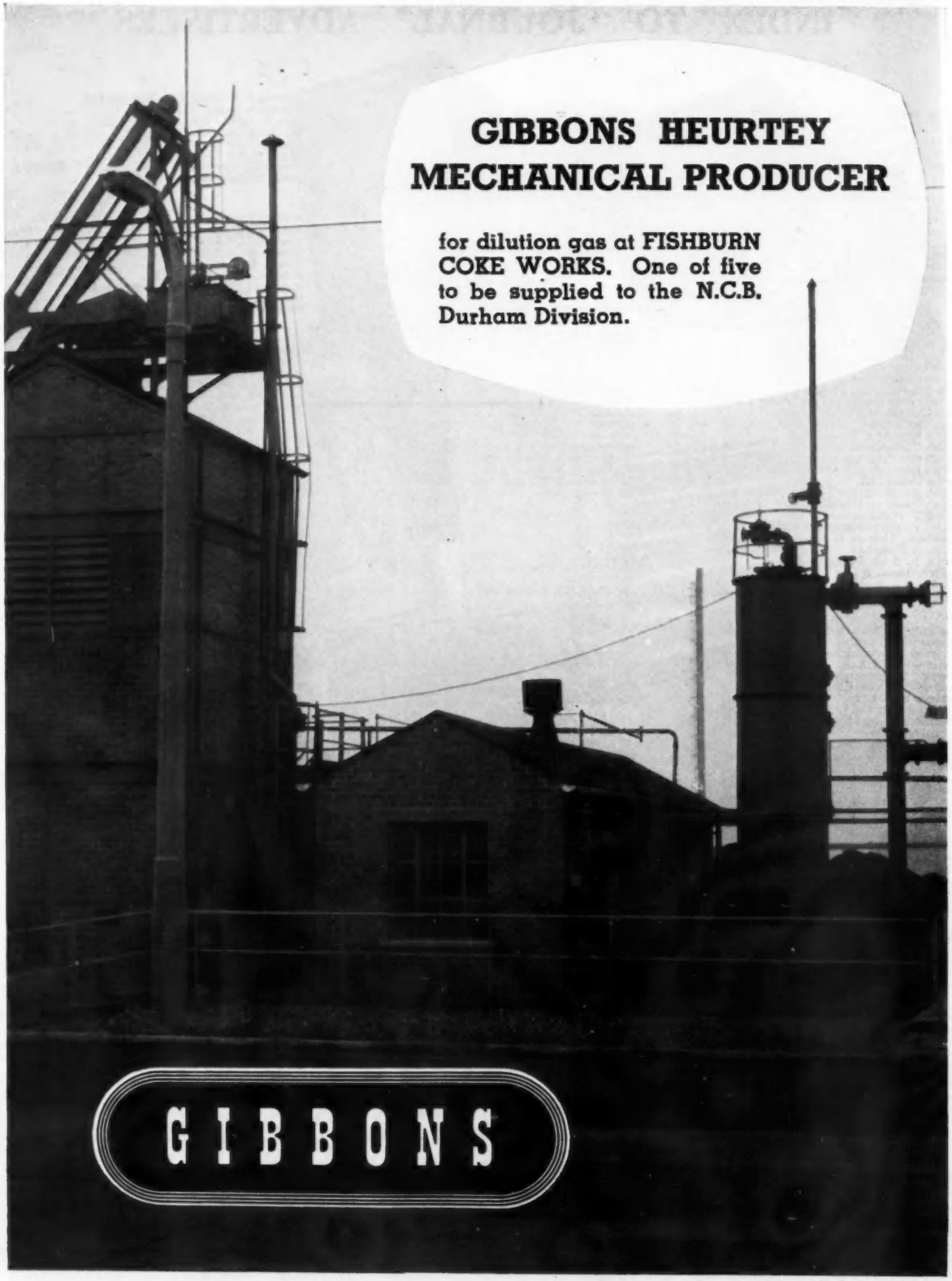
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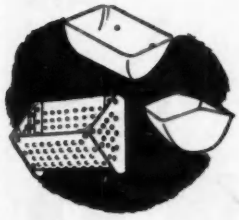

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Gas Journal

VOL. 289 *NO. 4889* *March 27, 1957*

109TH YEAR

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Gas Journal

VOLUME 289. No. 4889. MARCH 27, 1957. 109th YEAR

Contractors and the Gas Industry

THE specialist contractors to any industry are, or should be, an integral part of that industry, because much that goes on towards the development of plant or equipment is at the contractors' own expense. Some users of plant might like to modify this last point somewhat by saying that the buyer of the plant is the contractors' guinea pig. Though this may in actual practice be true, it is really the only way in which the contractors can try out their new ideas in the hard school of everyday working conditions.

The gas industry has always recognised the debt it owes the contracting side of the industry and is only too ready to show its appreciation by willingly granting the technical members of the contractors' staff full membership of the Institution of Gas Engineers. The contractors for their part have always given their best in the form of service and advice. This applies especially to the smaller undertakings before nationalisation. The contractors' wide experience of design and the workability of the newer systems of carbonisation or by-product recovery were of the utmost use to the engineer and manager of the more remote undertakings, which had decided to rebuild and wanted to install the most up-to-date plant which was reasonably in accord with possible expansion in the demand for gas and within the bounds of necessary capital expenditure.

Contractors are, however, business men and their technical representatives are salesmen as well as technologists. They live by the sale of their wares, and since nowadays their wares are becoming more and more expensive, the skill of salesmanship must be most cunningly combined with technical knowledge in order to find out what are the potential customers' needs and to strive to meet them. In so doing—by the supply of a particular make of plant—they must combine with its sale the complete satisfaction of the client by means of as good an after-sales service as can be included with the on-cost in the original prices.

The gas industry has been lucky in its contractors, who have developed designs of plant and equipment, refractory materials, and civil engineering work which have benefited the industry greatly, though perhaps in a few isolated cases some designs may not have been quite all that was hoped. Fortunately, however, the latter are few and perhaps the undertakings which were willing to try them out were carried away by their novelty instead of getting down to such really hard facts as maintenance and future workability.

With nationalisation the whole picture changed with almost bewildering speed. There were no longer any more small undertakings, and the area boards which took their place were large enough to employ their own qualified engineers in every branch, their own laboratories, and their own design draughtsmen. Thus any area board was capable of discussing the merits or otherwise of any design submitted by the contractors or of compelling the contractors to adopt for that particular board's own plant some special design or gadget. Whether it would be a success or not was hardly the responsibility of the contractor. Sometimes it was and sometimes, through no fault of the design but because of the unsuitability of the material from which it was constructed, it was a failure.

Having settled on the type of plant and from whom it is to be ordered, the area board will start to hammer out all the small outstanding points of design, capacity, and site with the contractors and eventually a starting date is announced and a completion date agreed to. This all sounds very easy and it is seldom that there is anyone on the clients' side, except the principal participant, who knows of the difficulties to be overcome on the contractors' side and how and with what degree of effort he carries out his promises.

In his paper 'Contractors' Delivery Promises and their Fulfilment' to the London and Southern Section of the Institution of Gas Engineers last week, Mr. I. H. Phillipps, of Humphreys and Glasgow, Ltd., revealed much that goes on behind the scenes.

Some contractors, Humphreys and Glasgow among them, manufacture practically nothing themselves but sub-contract for all the major portions of their plants as well as the ancillaries—pumps, blowers and electric motors—and are only themselves responsible for the design and drawing office work of a contract. For this reason such a firm may be very dependant on outside firms for the supply and delivery to site of component parts, with special emphasis on standard auxiliaries which, as Mr. Phillipps pointed out, are considered as part of the other firms' production programmes and not that of the main contractors. This then is the reason for the existence of 'expeditors' who, as the paper points out, must be men of character and in a position to talk at management level to extract promises which are meant to be, and have to be, kept. The extent to which the timing of a contract can be upset is most alarming. Mr. Phillipps told how, when the type of prime mover of a pump was changed from steam to electricity—a whole year before the completion date—there was a complicated chain reaction. The chief effect was felt in the drawing office where 19 new drawings and 103 new prints were needed, while further disturbances also took place in other departments involving requisitions and letter writing. The biggest setback, however, will occur when the client asks for ancillary plant of more recent design than that previously agreed to; more delays have been caused by this request than any other, but the client does not want an obsolescent plant delivered to him and considers it his right to make that possibility as small as it can be.

Looking at the whole situation as objectively and impartially as possible it must be remembered that at best we have two competitors each striving after perfection from his own particular standpoint—the one to buy a really satisfactory piece of plant at the lowest price, and the other to deliver and install equipment which will enhance the reputation of the firm, encourage future orders from his client, and keep the cost of doing so at a minimum.

I.G.U. Silver Jubilee

THE International Gas Union marks its Silver Jubilee by the issue of a very nicely printed pamphlet in which the story of the formation of the I.G.U. in 1931 and of its achievements since then is very briefly told, together with some account of its organisation and of its prospects for the future.

Prior to the formation of the I.G.U. international intercourse of gas engineers was mainly confined to the very welcome attendance of a few delegates from other countries at the meetings and conferences of the several national organisations. It was about 1930 that it occurred, simultaneously we are told, to French and British gas engineers, that this was not enough and that much good might come of a permanent organisation which would have for its objects, the study of everything relating to the gas industry and the promotion of its progress, the maintenance of friendly relations and fruitful discussion among its members, and particularly, the organisation of international congresses at regular intervals and in the different member countries, coupled with the publication of reports and papers submitted to and discussed at these congresses.

In our issue of September 5, 1934, Mr. Clifford King, on his way to Zurich, attributed the original suggestion to Monsieur A. Baril, Past President of the Association Technique de Gaz en France. At the Zurich meeting, M. Baril was elected as the second President of I.G.U. with Prof. Brender à Brandis of The Hague as Vice President.

The inaugural meeting was reported in our issue of June 10, 1931. It was held concommitantly with the 68th Annual Meeting of our own Institution with Mr. H. E. Copp presiding at the opening conference. Among other famous men present were Herr Fritz Escher of Zurich (who was elected first President of the Union), Mr. Clifford E. Paige and Major Alexander Forward (Managing Director, A.G.A.) representing the U.S.A., M. P. de Lachomette, France, and Mr. G. E. H. Zollikofer, Zurich, who was to play a long continued active part in the life of the Union.

Belgium, Germany, Holland, Norway, Sweden, Switzerland and the United States of America joined with France and Great Britain in the foundation of the Union in 1931. Today there are 17 member countries which are, in fact, the chief countries in the world where the gas industry is of real economic importance.

Meetings have generally been triennial, except when interrupted by war. They have been held in Zurich, 1934, Paris, 1937, London, 1949, Brussels, 1952 and in New York in 1955. The agenda covers national and international reports, and a certain number of individual papers. Of the reports, no doubt the most outstanding is the 'documented statistical study,' prepared by the Belgian Gas Association, presenting a most useful picture of the position of the gas industry in the several member countries.

Several important subjects of international interest and concern have been given particular prominence. Among these the question of education and vocational training was reported upon by our own Institution at Brussels in 1952 and at New York in 1955. Training schemes in the several member countries were examined and compared. Exchange of engineers and engineering students has been recommended, not merely to make a short trip but to spend a period of several months working in the gasworks of a foreign undertaking.

All these exchanges of ideas and this work of co-ordination come up against a difficulty which is common to them all, the language difficulty. The Union had already made a modest contribution to the solution of this problem by the publication in 1937 of a Gas Industry Vocabulary in three languages. There is now in preparation, by a Vocabulary Committee with financial assistance from UNESCO, a technical vocabulary in seven languages. Experts from the national organisations are collaborating in this work which should result in a most useful aid to technicians in every interested country.

There is no doubt that the International Gas Union has performed during its 25 years of life, and will continue to perform, a most useful function, not only in the broadening of vision of the technicians and administrators of the gas industry in its member countries, but in keeping before world organisations at the highest levels the importance and usefulness of the gas industry in the production and distribution of energy in the service of mankind.

Personal Notes

MR. A. P. WICKENS is appointed Managing Director of Vickers-Armstrongs (Tractors), Ltd., and ceases to be a Director of Vickers-Armstrongs (Engineers), Ltd., and General Manager of the Elswick, Scotswood and Wakefield works of that Company. MR. J. R. KELLY is appointed General Manager of the Elswick, Scotswood (excepting the tractor business) and Wakefield works of Vickers-Armstrongs (Engineers), Ltd. MR. J. G. LLOYD is appointed a Director of Vickers-Armstrongs (Engineers), Ltd., and General Manager of the Crayford, Dartford and Thames ammunition works of that company. LT.-CMDR. R. B. LAKIN, D.S.O., D.S.C., is appointed Managing Director of George Mann & Co., Ltd.

MR. W. R. OWEN, Manager of the Sheffield branch office of Honeywell-Brown, Ltd., has been promoted to Manager for the North East region. He will now be responsible for making comprehensive instrumentation facilities available to industry in that area by opening and staffing additional offices and by forwarding recommendations for extensions to the range of equipment available. MR. A. HAGUE, Mr. Owen's deputy for the past three years, succeeds him as Manager of the Sheffield office.

MR. JACK POWELL THOMPSON has severed 25 years' association with Newbury and District Gas Undertaking as Engineer and Manager. He was appointed in 1932, after having been for four years in charge of the local undertaking at Barnoldswick, Yorkshire. His retirement ends a line of Newbury engineering managers which stretches back to 1825, for in future the work will be controlled from Reading. Before he left he received a pair of binoculars at the hands of Mr. A. V. Begley, the works superintendent.

MR. HUGO FALK, Chairman and Managing Director of Falk, Stadelmann & Co., Ltd., recently attended a dinner held in his honour on the occasion of his celebrating 50 years' service with the company. Sixty-five people attended the dinner, at the Trocadero restaurant, London, including the Board, branch and works managers, and sales representatives and warehouse staff with over 40 years' service.

MR. C. G. BROOK, General Manager of National Benzole Co., Ltd., retires on May 31 after 37 years' service. MR. A. M. ROBERTSON, General Manager of Scottish Oils and Shell-Mex, Ltd., has been appointed General Manager designate from April 1, and will succeed Mr. Brook on his retirement at the end of May.

MR. JOHN DEREK BERRESFORD, Commercial Manager of the Staveley Iron and Chemical Co., Ltd., near Chesterfield, has been appointed a Director of the Company.

MR. W.V. SHEPPARD, General Manager of No. 1 (Chesterfield) Area of the East Midlands Division, National Coal Board, has been appointed Director-General of Reconstruction at national headquarters, in succession to MR. H. E. COLLINS, whose appointment as a Member of the National Board was announced by the Minister of Power at the end of last month. He takes up his new appointment on April 1.

MR. J. M. PUMPHREY, O.B.E., Production Director of the Northern (N and C) Division of the N.C.B., has been appointed Deputy Chairman of that Division, succeeding MR. H. W. HEMBRY, who, in January, was appointed a member of the National Board. MR. J. BRASS, General Manager of No. 1 (Manchester) area of the North Western Division, will succeed Mr. Pumphrey as Production Director of the Division on April 15.

MR. W. R. H. LORIMER, Distribution Superintendent and Sales Manager with the Alnwick unit of the Northern Gas Board (Blyth Division) has retired at the age of 65. Mr. Lorimer has been associated with the gas industry in the Alnwick area for about 30 years, and was a gas company director before nationalisation of the industry.

MR. J. C. INGRAM, Secretary of the West Midlands Gas Board, is to leave the gas industry to take up in May an appointment in London with a firm of management consultants.

MR. GEORGE COOPER DIXON, Distribution Superintendent with the Blyth unit of the Northern Gas Board, has completed 50 years in the gas industry.

MR. FRANK DAVIES and MR. P. E. DAW have been appointed Directors of Bratt Colbran, Ltd.

MR. GILBERT WILD has been appointed Advertising Manager of National Benzole Co., Ltd.

New Belfast Gas Price Increase is Approved

BELFAST CORPORATION has approved a Gas Committee recommendation increasing the price of gas by 6¼d. net per 1,000 cu.ft. The increase, which will come into force at the next meter reading, will cost the householder an average of 3d. per week more. There will be comparable increases in the case of auto-consumers.

The increase, brought about by rises in loan charges, labour costs, and coal prices, will bring in about £116,000 per year. The department uses about 240,000 tons of coal per year.

North Down Hospital Management Committee has approved proposals for the provision of emergency lighting and heating in the event of future electrical failures.

These include the adaptation of all available gas points and the extension of the gas service throughout parts of the hospital, with all possible safeguards.

ST. DAVID'S DAY CELEBRATIONS

TO mark the occasion of St. David's Day—March 1—this year, the Wales Gas Board arranged for a chain of 22 undertakings in the South Wales area to stage cookery demonstrations in their showroom windows. Home service advisers, dressed in traditional Welsh costume, cooked delicious cakes, which is an essential part of any Welsh celebration. These cakes were offered to the public.

The city showrooms of the Cardiff undertaking needed more than ½ cwt. of flour to satisfy the onlookers.

At the Tredegar undertaking, the school children, after performing a little play in honour of the Saint's birthday, were taken through the town to the gas showroom, and each were presented with cakes and a memento of the event.

Coinciding with the demonstrations was the issue of the new Welsh cookery book 'Croeso Cymreig.'

Diary

March 28.—SOCIETY FOR ANALYTICAL CHEMISTRY, MIDLANDS SECTION: Gas Showrooms, Nottingham. 'Analysis of Complex Sulphur Compounds,' discussion to be opened by C. E. Kendall. 7 p.m.

March 29.—WALES G.C.C.: Gas Board offices, Bute Terrace, Cardiff. 11 a.m.

April 2.—INCORPORATED PLANT ENGINEERS, EDINBURGH BRANCH: 25, Charlotte Square. 'The Generation and Use of Steam.' 7 p.m.

April 3.—INSTITUTE OF FUEL: Institution of Civil Engineers, Great George Street, London, S.W.1. 'Experiments Concerning the Effect of Coking Pressure in Full-Scale Operation of Coke Oven Plant,' J. L. Lambert, 5.30 p.m.

April 3.—NORTH WESTERN FUEL LUNCHEON CLUB: Engineer's Club, Albert Square, Manchester 2. 'The Impact of the Scientific Age.'

April 5. — LONDON AND SOUTHERN JUNIORS: 'Industrial Application of Air Heating by Gas,' H. R. Cooke.

April 6.—EAST OF SCOTLAND JUNIORS: Gas Showrooms, Falkirk. Address by Dr. Waddell. Visit to Grangemouth gas works in morning.

Sir Harold Talks of New Gas Process

TEST PLANT FOR NORTH WEST?

EXPERIMENTS with a new process of oil gasification which may lead to an entirely new method of gasifying coal were referred to recently by Sir Harold Smith, Chairman of the Gas Council, when he performed the ceremony of putting into commission a new 36-in. main from the North Western Gas Board's St. Helens holder station at Pocket Nook to the plate glass works of Pilkington Brothers, Ltd., the world's largest glass-makers.

Sir Harold said that these experiments at the Gas Council's Midlands Research Station had now reached such a stage under the direction of Dr. Dent as to justify the erection of a plant to test the process on a small commercial scale.

Near Oil Refinery

'Subject to various decisions which have still to be taken, it seems likely that this plant will be erected in the North West, probably near an oil refinery,' he said.

Sir Harold referred to another development which would be of great interest, if it materialised as it seemed likely to do very soon now. This was the liquefaction of methane from natural gas in the United States, and its shipment to this country in specially constructed tankers.

'It is beginning to look as if this is not only possible but probable,' he said.

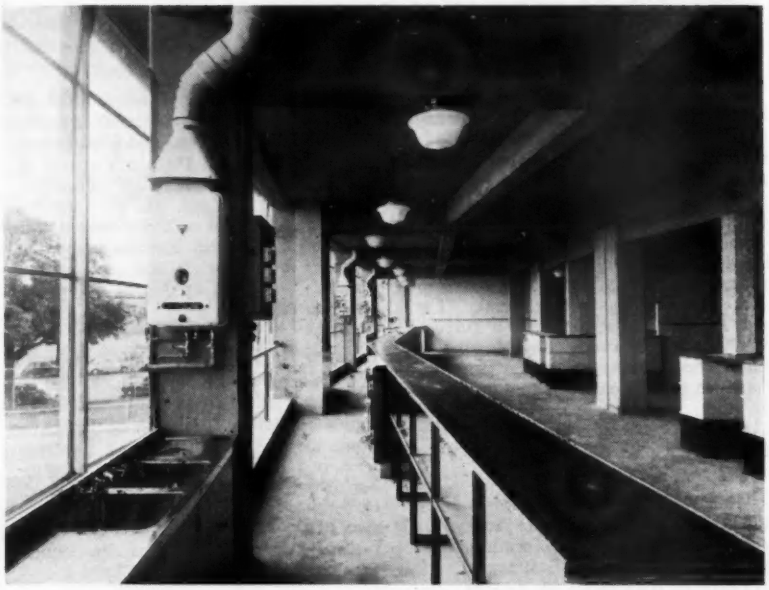
'We in the gas industry are indeed on the threshold of a most exciting era of dramatic and unprecedented progress,' Sir Harold stated.

After inspecting the North Western Gas Board's new compressor house at the St. Helens works, Sir Harold visited the new £4½ mill. works of the Board at Denton.

DE-TARRER WILL INCREASE REVENUE

COLERAINE BOROUGH COUNCIL has adopted a Gas Committee recommendation that a reconditioned de-tarrer be purchased at a cost of £1,949, and that the Gas Manager, Mr. T. R. Cameron, be authorised to inspect the plant at Huddersfield. The Manager estimated that the installation would increase annual revenue from tar sales by £390.

It was decided that a new scale for large consumers be adopted from April 1, and that a scheme be introduced whereby employees of the department would be paid a commission for introducing sales of gas appliances.



Sixty-four large multipoint heaters and twenty boiling water heaters were installed at various points in the athletic stadium, Olympic Park and Village, Melbourne cricket ground and stadium, and various exhibition buildings at the recent 16th Olympiad, Melbourne. The bulk of the boiling water heaters were installed in the Olympic Village first aid shelter, and the Melbourne cricket ground and Olympic Park claimed most of the multipoints. Our photograph shows heaters fitted in the cafeteria of the athletic stadium. This is a circular building, and heaters were installed on columns, each heater serving two sinks, one sink directly below the appliance and one 20 ft. into the centre of the building.

MANCHESTER JUNIORS WATCH THEIR COAL PREPARED

Choice of Visits as N.C.B.'s Guests

MEMBERS of the Manchester District Association of Junior Gas Engineers saw the preparation of coal before its distribution for domestic and commercial purposes at the Mosley Common colliery (No. 1 pit) at Walkden, Lancashire, which they visited on March 20. The colliery, which is in the North Western Division of the National Coal Board, Manchester area, employs 3,200 people and produces 3,000 tons of coal per day, a third of which goes to the North Western Gas Board.

With the assistance of guides the visitors were able to see the manœuvring of coal from the pit head by a conveyor system to the screens, washery and eventually the trucks which transport it to destinations. Alternatively they had the opportunity of seeing how, while on the conveyor, large lumps of coal were split, or broken down, by heavy picks and such foreign matter as metals was extracted by a massive magnet; how coal was pulverised and the dust taken away to be mixed with pitch for the making of briquettes by a plant turning out 69 briquettes per minute.

These briquettes, which are moulded to a convenient size, are in demand at £7 10s. per ton, and can be used, our correspondent was told, for every purpose to which coal is put.

A visit was also made to the huge methane gas plant.

During a break in the tour, Mr. W. A. Green, Coal Preparation Engineer, and Mr. W. H. Berry, Manchester area Marketing Manager, answered many questions.

The pit produces 600 tons of coal per hour. To eke out the supply more coal is brought to the plant from sister collieries and blended with their own so that the plant works at full capacity. Altogether in two shifts they deal with about 7,400 tons of coal and that did not reach the full possible output. The plant is the Barboys type, capable of washing 600 tons per hour of run-of-mine fuel by dense, medium and Hoyoise processes. All fuels above ¼ in. pass through a dense medium bath at a specific gravity of 1.4; those below ¼ in. go through the Hoyoise washing trough.

The coal preparation plant operates from 6 a.m. to 10 p.m. and deals with a daily tonnage of 7,000 from which 1,800/2,000 tons is discarded and conveyed by lorries one-and-a-half miles to a dirt tip. The fuels are used for house, steam, gas and electricity purposes at various prices according to analyses.

Asked if the discarded shale could be made a commercial asset, Mr. Green replied that that was the big problem.

From a paper to the Manchester and District Section on March 15.

Oil Gasification at York by the Segas Process

By F. H. NICHOLLS, M.Sc., M.Inst.Gas E.

ENGINEER AND MANAGER, YORK DISTRICT, YORK-HARROGATE GROUP, NORTH EASTERN GAS BOARD

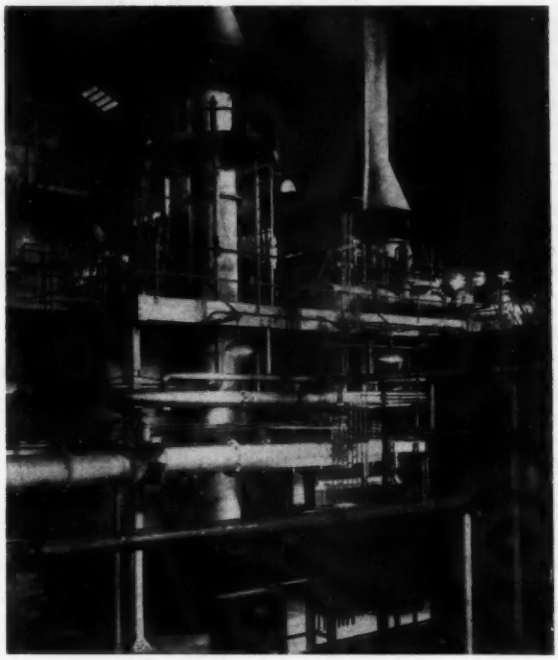
THE use of petroleum oil as a raw material for the production of town gas has a history almost as long as that of the gas industry itself, for within ten years of the commercial production of coal gas there was in existence an oil gas company in Liverpool. Little or no development took place in the use of oil until the introduction of carburetted water gas plants some 70 years ago. Since then gas oil has performed a relatively minor, but nevertheless vital, function in gas manufacture. It is only within the last decade or so that processes of oil gasification other than in C.W.G. plants have aroused significant interest and attention in this country.

It is a matter of concern to an industry predominantly based on coal that the annual production of coal appears to have become stabilised, and it has been estimated that the gap between coal production and potential coal consumption will be of the order of 50 mill. tons of coal equivalent by 1964. Utilisation efficiencies will doubtless improve and atomic power become increasingly available, but oil as a supplement or alternative to coal will inevitably continue to be of great importance to the national economy.

The paper 'The Production of Town Gas by the Catalytic Gasification of Petroleum Oils' by Stanier and McKean described work done to 'develop a process of gasification giving an oil gas of calorific value and density not dissimilar to town gas as normally distributed.' This process is one of gasifying oil in steam in the presence of a catalyst, and an account is given of the selection and preparation of the catalyst and of experiments on a laboratory scale which established the practicability of the process and showed remarkable yields of gas without carbon deposition or production of tar. Experiments on a pilot plant confirmed the soundness of the process in principle but so many difficulties were encountered that there was insufficient data for the design of a commercial unit. The paper concluded with a reference to the erection of an experimental plant with a nominal capacity of one mill. cu.ft. per day.

As a result of the paper, and in collaboration with Power-Gas Corporation Ltd., a commercial unit of a similar size was designed and orders were placed by the South Eastern and the North Eastern Gas Boards. The S.E.G.B. plant was erected at Sydenham and began gasmaking in February, 1953. The N.E.G.B. plant was erected at York. Although the order was placed in 1951, completion was delayed because of foundation work and a re-arrangement of priorities of the Board's constructional activities so that gasmaking did not begin until July, 1954. The plants of the two Boards are generally similar in design but some modifications were incorporated in the York plant.

The terms of reference were to determine operating conditions which would produce an optimum yield of gas over a range of calorific values, and it should perhaps be emphasised at this point, that the approach to the problem was to be empirical; the plant as built was a commercial unit; the oil to be gasified would be a normal commercial product of the suppliers (the 'specification' of the oil actually used was limited to a statement of its viscosity without reference to other physical properties or chemical constitution); the gas produced had to be accepted into the production stream. The plant operators were recruited from applicants from the carbonising personnel, and supervision of the plant operation was carried out by the existing works technical staff with periodic assistance from the manufacturers and head office. A more academic approach might have been desirable but circumstances dictated differently. Between the dates of initial gasmaking of the Sydenham and Yorks plants considerable thought was given to problems that could arise and how they might be overcome, and a number of discussions took place between representatives of the two Boards and the manufacturers with complete frankness on all sides.



General view of plant

The breakdown of hydrocarbons in petroleum oils to gases similar to town gas involves a decrease in the carbon : hydrogen ratio of the constituents. There is, so to speak, carbon to spare.

TABLE I.—TYPICAL C/H RATIOS

Anthracite	31	Olefines	6
Bituminous coal	15	Acetylenes and higher paraffins	approaching 6
Petroleum oils :			
P.F.D.	4.9	Benzene	12
Petrol	5.8	Condensed rings	>12
Gas oil	6.3	Methane	3
Fuel oil (200 secs.)	7.0	Town gas	3.1
Heavy fuel oil (950 secs.)	7.8	'CnHm'	2.7-4.0

The reactions which take place during the thermal decomposition of hydro-carbons are exceedingly complex and have been the subject of study since 1809 when Dalton and William Henry conducted experiments on the effect of passing electric sparks through methane and ethylene. Armstrong and Miller in 1886 examined oil manufactured from petroleum and showed the presence of ethylenic and benzenoid hydrocarbons where both groups were derived from paraffins. Haber in 1896 found that the higher paraffins at 600°C. to 800°C. gave the next lower olefine and methane, and aromatics gave more complex molecules and free hydrogen.

The classic work was that of Bone and Coward who in 1908 published a paper on the thermal decomposition of the simple hydrocarbons: Methane, ethane, ethylene and acetylene, which may be summarised as follows.

Methane is the principal product of decomposition of ethane, ethylene and acetylene. It is a very stable gas but decom-

position takes place slowly at about 1,000°C. and becomes more rapid with increase of temperature. It decomposes directly to carbon and hydrogen in a reversible reaction which is almost entirely a surface phenomenon taking place in highly condensed gas layers in contact with hot surfaces. The carbon deposited from methane is hard and lustrous, not dull and soft. The decomposition of ethane, ethylene and acetylene is in no case a surface reaction but takes place in the main body of the gas.

Ethane is relatively unstable at temperatures below 700°C. and yields ethylene and hydrogen readily, with a gradual build-up of methane at the expense of ethylene. A little acetylene was found together with some naphthalene and tar and considerable quantities of carbon. At higher temperatures the main product was methane but at 1,140°C. to 1,185°C., at which temperatures methane is broken down, the products were almost entirely carbon and hydrogen.

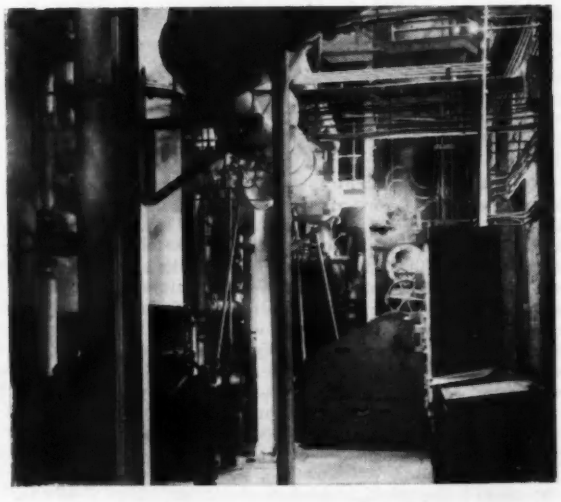
Ethylene decomposes at low temperatures (about 570°C.) to acetylene with ethane, methane, hydrogen and some aromatics, but without decomposition to carbon. At higher temperature decomposition is exceedingly rapid, more carbon is deposited and the ratio of methane to hydrogen increases due to hydrogenation to hydrocarbon radicals.

Acetylene polymerises at comparatively low temperatures (600°C. to 700°C.), so that when it is a principal decomposition product there occurs a marked secondary formation of aromatics. The maximum polymerisation occurs at the quoted temperatures but is negligible at 1,000°C.

The extent to which the reactions thus described occur is dependent not only on temperature but on the length of time that the temperature is maintained, so that it is therefore virtually impossible to determine equilibria however complex and, except in the case of methane, no simple chemical equation can adequately represent the decomposition of a hydrocarbon. But Bone and Coward showed that some idea could be formulated of what was likely to happen in particular circumstances. The most noteworthy effect in their investigation was the potential formation of methane from all the other hydrocarbons and its stability at temperatures below 1,000°C. This they explained as due to the momentary formation of the radicals: .CH, :CH and ⋮CH, which were immediately converted in the presence of hydrogen to methane.

This description of the thermal decomposition of the simple hydrocarbons makes it easier to understand the thermal cracking of the more complex hydrocarbons in petroleum oils. The paraffinoid and ethylenic constituents consist of long-chain compounds which can be cracked to shorter-chain compounds and ultimately to simple hydrocarbons. At low temperatures the paraffin chain will crack near the middle forming a paraffin of lower molecular weight and an olefine which can then be further cracked. At higher temperatures cracking will take place nearer the end of the chain and yield an olefine and methane or one of its near homologues.

The olefines in petroleum, whether there originally or derived from cracked paraffins, split off methane at the end of the chain farthest from the double bond and yield diolefines which in turn may polymerise to tarry substances. The side-chains attached to aromatic nuclei can be similarly split off and cracked leaving simpler chain and ring compounds which, if subjected to continued heat treatment, will themselves be further acted upon. The naphthenes and cyclo-paraffins in the lighter distillates lose their side-chains to form benzene or naphthalene which appear in the gas, and anthracene which condenses in the tar.



Reaction vessels and automatic operator

Chemically the primary reaction of the breakdown of the simple hydrocarbons is the rupture of the C-H bond, whereas rupture of the C-C bond is secondary. With hydrocarbons of higher molecular weight the primary reaction is rupture of the C-C bond, whilst rupture of the C-H bond is secondary. Both reactions are endothermic. Polymerisation and isomerising reactions which are exothermic will also take place.

The products of decomposition of petroleum oils are dependent, therefore, on the constitution of the oils, the temperature and duration of the heat treatment, and on the extent of contact of the gases with hot surfaces. As a result of the interplay of these conditions there will be gaseous and liquid products, some of which may condense to tars and the formation of carbon which may be of hard texture (cf. the formation of retort carbon) and resist removal by physical or chemical means.

High Calorific Value

The gaseous products of thermal cracking alone are of high calorific value and to obtain such products with the calorific value of normal town gas there must be added an oxidation process using an agent such as steam, air, oxygen, or mixtures of these, which can be speeded up by the use of catalysts. Cracking in steam gives larger gas yields with more combustible carbon in the gas, but conditions are also favourable for the formation of CO_2. There is a good deal of support for the view that the primary reactions are also activated by oxidic catalysts in the presence of steam. Unfortunately much of the work described in the very extensive literature has been carried out at temperatures which seldom exceed 700°C., with catalysts incorporated with the oil, and the reactions allowed to proceed to finality. The statistical results obtained and the conclusions drawn from them are, in general, capable of only limited application to the conditions present in a plant such as the one under discussion where the catalyst has only a low activation value, the time-contact is short and the temperature approaches 1,000°C. Until our knowledge has been greatly extended there is no alternative to large-scale operation in seeking to establish optimum conditions of conversion.

Even a superficial examination of the economics of oil gasification processes shows that by far the largest single item in production cost is that of oil. The S.E.G.B. had successfully operated on relatively high-priced gas oil, but with reasonable efficiency of gasification, the lower-priced distillates would be more likely to yield a gaseous therm at a cost comparable with other gas-making processes. So an early proposal to prove the plant on gas oil was not proceeded with, and it was decided to start the plant up on 950 secs. heavy fuel oil, with a maximum viscosity of 950 secs. Redwood No. 1 at 100°F. To ensure fluidity the oil is heated at the depôt and brought to the works in road tankers, from which the tankers' own pumps deliver it to bunded vertical storage tanks. A primary heater at the base of each storage tank renders the oil sufficiently fluid to be pumped through heated and lagged pipes to a secondary heater and so to the plant.

Table 2 gives typical data of some of the fractions produced from crude petroleum. Though typical, these data are not precise since the suppliers may vary the range of the distillation fractions.

TABLE 2.—CHARACTERISTICS OF FUEL OILS

	P.F.D.	Gas oil	Medium fuel oil	Heavy fuel oil	Extra heavy fuel oil
Viscosity : Secs. Redwood No. 1 at 100°F.	—	35	200	950	3,000
Specific gravity ..	0·64	0·84	0·95	0·96	0·97
Sulphur : %	<0·1	<1·0	2·7	3·5	3·6
Ash : %	—	0·01	0·03	0·04	0·07
Conradson carbon : %	—	—	7·5	10·0	12·0

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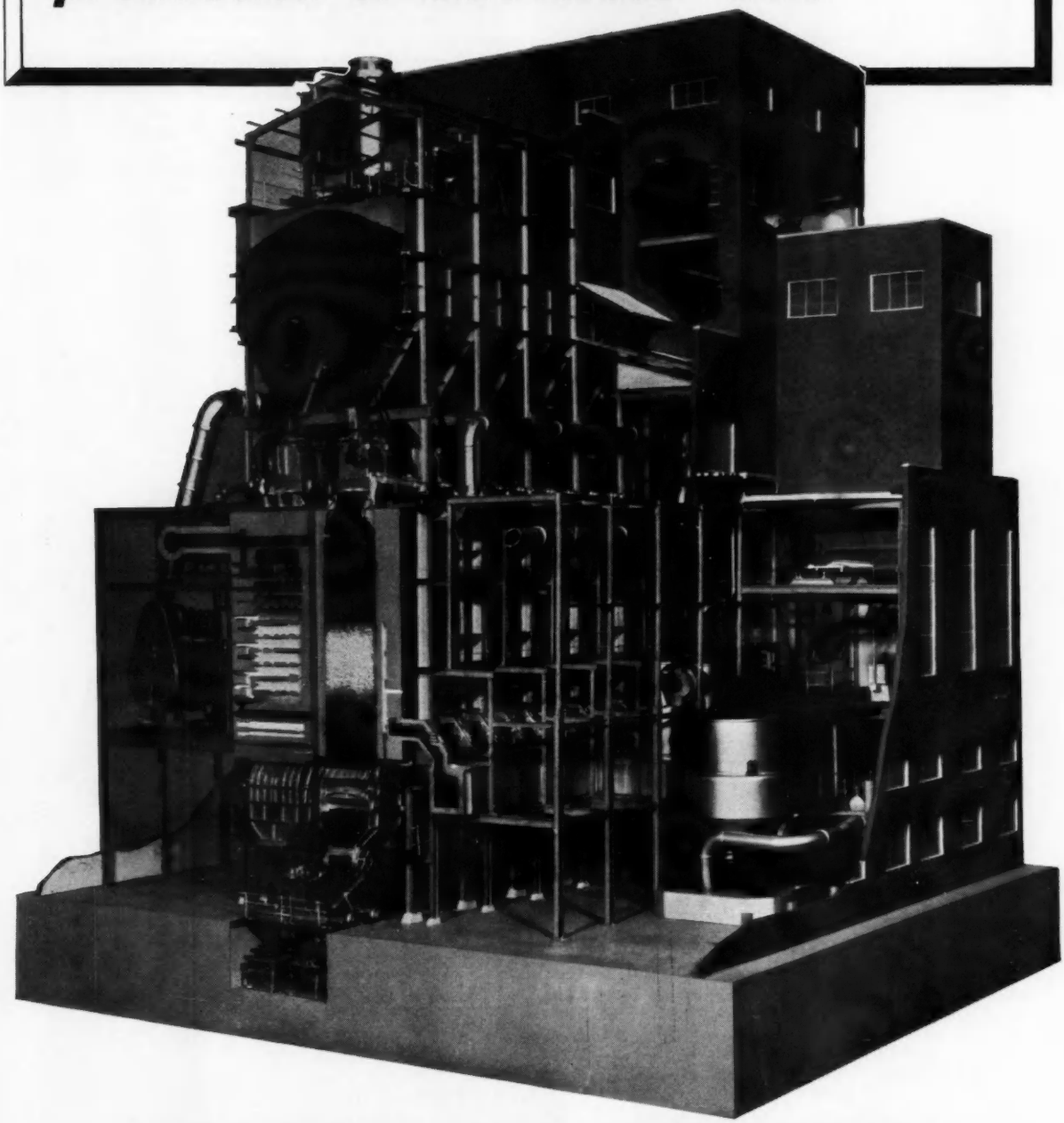

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The heavier fuel oils contain an increasing proportion of Conradson carbon, which is the amount of carbon residue left when an oil is evaporated under specified conditions of test, and this contributes to the high C/H ratio of the heavier fractions.

The experience of heavy oils in C.W.G. and oil gas plants in the U.S.A. is given in 'The Productivity Team Report on Gas.'

Greater use of heavy oils in the U.S.A. has been encouraged by an anticipated scarcity of gas oil and the need to use a cheaper oil, but difficulties were caused in practice by the deposition of carbon and the formation of refractory tars. Heavy deposits of carbon in process vessels and mains made daily shut downs necessary and the work of removal was long and arduous. The result was a serious loss of plant capacity and the loss of any price advantage in using heavy oils. The remedy proposed was the careful selection of oils with a low sulphur and ash content and a limit of 5-6% of Conradson carbon. Shut downs for carbon removal then occurred only every third day and the use of back-blast enabled plants to work for as long as three months before a shut-down for cleaning became necessary, but the process details needed to be modified and gasmaking potential was always less than when gas oil was used.

Tar emulsion troubles with water contents of 50% to 90% began with 5-6% Conradson carbon oil and as such emulsions are very stable and do not respond to simple separation and moderate heat treatment, more drastic treatment, such as hot tank separation, centrifuging, and flash dehydration was needed. The effect of heat treatment was to increase the viscosity by removal of the light fractions and to polymerise other constituents. A wetting agent, however, was often effective in reducing water contents to 10% or less.

The basis of the Segas process is the thermo-catalytic decomposition of complex hydrocarbons in the presence of steam and a lime-magnesite catalyst so that cracking and oxidising reactions occur simultaneously. The carbon which does not undergo these reactions, and is therefore deposited, is removed by air-blast. The heat of its combustion is absorbed by refractories and the catalyst to restore working temperatures. These operations are arranged to be cyclic, the travel of steam/oil and of air-blast being in opposite directions, giving a 'make' period followed by a 'blow' period.

The plant at York consists of a catalyst vessel situated between a steam preheater and an air preheater. Each vessel is a steel shell lined with refractory and insulating brickwork.

The steam preheater is 8 ft. 6 in. diameter and 16 ft. 6 in. high and is packed with refractory chequers. A connection from the bottom leads to the main stack. At the top there is a connection to the top of the catalyst vessel.

The catalyst vessel is also 8 ft. 6 in. diameter and 16 ft. 6 in. high, the catalyst material, which is in the form of rings, being carried on a tiled floor on arch supports. The refractory and insulating lining is 1 ft. 3 in. thick, the space available for the catalyst being 6 ft. diameter and 8 ft. high, equivalent to a volume of 226 cu.ft.

A connection at the bottom of the catalyst vessel leads to the air preheater, a vessel 7 ft. 9 in. diameter and 21 ft. 6 in. high. This vessel also contains refractory chequers. Near the top an off-take leads to the washbox and there is also provided an auxiliary stack which is brought into use when the plant is started up and during reverse-blowing.

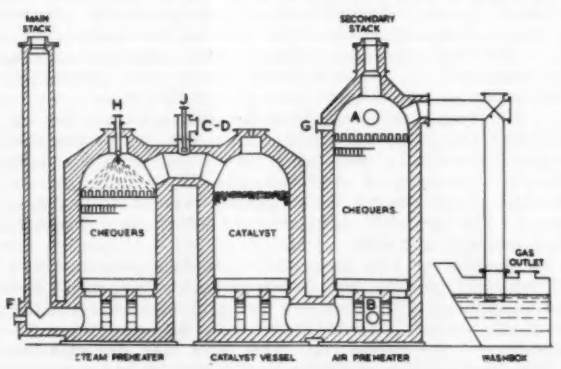

Fig. 1. Diagrammatic section through plant—(a) primary air; (b) auxiliary air; (c) secondary air; (d) reverse air; (f) process steam; (g) purge steam; (h) oil; (j) heating gas.

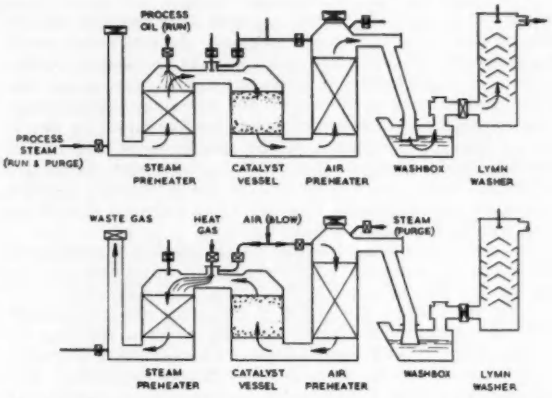

Fig. 2. Diagram of Segas process showing path of gases during run and blow periods.

The cycle is controlled by an automatic mechanical operator driven by an electric motor, the power of which is transmitted and directed through a series of automatic mechanical couplings so that the valves required to be operated open and close in correct sequence. The automatic operator is a standard 7-train unit with a safety system of interlocking gear to prevent the operation of the valves other than in their set sequence. Safety trip gear is brought into play should any part of the mechanism endeavour to operate out of sequence, in which case the plant would be brought to a safe position and the driving motor stopped.

The make portion of the cycle is as follows (Fig. 2): Oil is pumped from the storage tanks through a spiral plate steam/oil heat exchanger of Rosenblad design and, at a temperature of 210°F. and a pressure of 100 p.s.i., is led to the top of the steam preheater where it is atomised in a downward direction through a suitable spray. Here it meets steam which has entered the steam preheater at the bottom and the temperature of which has been increased to over 500°C. by passage through the refractory chequers. The steam/oil mixture now enters the top of the catalyst vessel and travels downwards through the catalyst. Oil is injected into the preheater for only a portion of the gas-making period, but the passage of steam is continued to carry on the reaction with deposited carbon and to act as a purge, this latter being referred to as continuation steam. The gasification products and excess steam pass from the bottom of the catalyst vessel into the bottom of the air preheater in their upward travel through which they yield heat to the refractory chequers. They then pass to the washer seal box, which in the York plant is of special design. The crude gases are cooled and washed by direct contact with a downward stream of water in the Lymn washer where steam and some tar are condensed. From the Lymn washer the gas is led to a naphthalene washer and to a Connersville meter for metering. The gas is now led to the C.W.G. relief holder where it joins the C.W.G. stream and continues by way of exhausters, electrostatic tar precipitator, tray purifiers to inlet holder.

During the gas-making period temperature distribution throughout the catalyst material changes considerably. The overall temperature falls, the drop in temperature in the hotter zones not being compensated for by a smaller rise in the coolest zones. Primary air enters the air preheater at the top and absorbs heat stored in the chequer-work before passing into the bottom of the catalyst vessel where deposited carbon is burnt off and the temperature of the catalyst is restored to its former levels. The products of combustion, together with excess air, pass downwards through the steam preheater and give up sensible heat to the chequer filling before being led away to the main stack.

Auxiliary air as secondary and tertiary supplies can be fed to the bottom of the catalyst vessel or to the top of the steam preheater as circumstances require, to give more direct control of carbon removal at this point or to adjust the temperature and its distribution. A steam purge following the blow period completes the cycle.

At the base of the air preheater there is provision for a supply of town gas at a pressure greater than any that can be built up due to conditions in the plant. An anti-surge vessel and an excess pressure valve allow continuous running of the gas booster. The functions of this gas supply cover drying out of the plant, starting up from cold, and affording supplementary heat during the gasification process. Auxiliary heating gas is also supplied to the bottom of the catalyst vessel and to the inter-connection between the catalyst vessel and the steam preheater. Town gas was chosen for these purposes because of its convenience and ease of control, but a change-over to tar or oil burning is ultimately contemplated.

The catalyst employed is an oxidic catalyst capable of accelerating the pyrolytic break-down of hydrocarbons and the reaction between steam and carbon. It is a commercial product obtained by mixing a pure form of magnesite and precipitated chalk with a binder and sufficient water to allow the mass to be shaped by moulding or extrusion. After drying it is heated to 1,400°C. for some hours. It is highly refractory and mechanically strong.

Preparation of Catalyst

The catalyst was originally prepared in three sizes, but the largest size, 6 in. diameter and 3 in. long, was discarded. The other sizes are in the form of annular rings, the large size being 2½ in. long, 2½ in. O.D. and 1 in. I.D. The small ring is nominally 1½ in. long, 1½ in. O.D. and ½ in. I.D., but a considerable proportion have been found to be 1⅛ in. O.D. These dimensions indicate that the rings are geometrically similar but other properties are not so obvious. For random packing the solid volume of catalyst and the free space are equal. Hence the heat capacity per unit volume of random packed catalyst is the same whether large or small rings are used and, for any particular steam/oil mixture, the theoretical residence time is the same whether the reacting gases pass through large or small rings. The apparent surface areas per cubic foot of catalyst in random packing are: Large rings, 21.1 sq. ft.; small rings, 48.8 sq. ft.

From the works operational angle, and bearing in mind that the plant was to be run by existing staff, it was important that it should work as smoothly and continuously as possible.

It was of great help in formulating our approach to have the benefit of experience derived on the Sydenham plant of the S.E.G.B. As was to be expected, such discussions omitted the successes of operation and concentrated on the difficulties, which included the possibilities of excessive back-pressure due to deposits of carbonaceous and tarry matter, the emission of oil smoke at the stack and the presence of considerable amounts of naphthalene in the gas produced. It was concluded that the central problem was the effective control of catalyst bed temperatures. The studies of hydrocarbon pyrolysis alluded to earlier in this paper demonstrated that the temperature employed should be as low as possible consistent with a satisfactory speed of reaction. Since the degradation of methane to the hard and unreactive form of carbon is inappreciable below 1,000°C. the optimum temperature was assessed at 950°-980°C. At these temperatures it was considered that gaseous yields would be at a maximum and that carbon deposition and polymerising reactions, including naphthalene formation, would be at a minimum.

The way in which the available heat would be distributed throughout the catalyst could only be determined by experiment. It was felt desirable that the top layers of catalyst should be at a temperature as near as possible to that of the central zone.

To achieve this three factors were considered of prime importance. The first was that the top of the steam preheater should be as hot as practicable in order that process steam entering the catalyst vessel should reduce the catalyst temperature by a minimum amount.

The second factor involved modification of the plant. The catalyst vessel as designed and erected included air and steam ports on the periphery of the shell at half the height of the catalyst bed. It was felt that their use could induce an unfortunate progression of events. Heavy carbon deposits could be taken as a sign of too high a temperature. Direct supplies of air would undoubtedly burn off some carbon but would thereby further increase the temperature. Rat holing and hot pockets could also be expected. Local overheating would result in conditions favourable to further carbon deposition which in turn would cause more overheating and a vicious circle be set up. The ports were therefore blanked off and no air or steam has been applied at these points.

The third and major factor concerned the position of oil injection. In the original designs and plants the oil had been injected at the top of the catalyst vessel.

It was decided that, from the start, all the oil should be sprayed into the steam preheater. Several advantages were anticipated. The atomised oil would meet the up-current of preheated process steam, its temperature being raised to within a few degrees of that of the steam. It was visualised that before reaching the catalyst the greater part of the oil would vaporise and become completely admixed with steam. The heavier fractions would be in the form of vesicles shrouded in steam. There would then be a minimum of pyrolytic cracking in the short travel to the catalyst bed and a maximum opportunity for oil/steam/carbon catalytic cracking. In addition, there would be a tendency for Conradson carbon to be thrown down on the steam preheater chequers rather than on the catalyst, and its removal by combustion would give additional heat to the steam preheater.

The decision to inject all the oil into the steam preheater has completely justified itself and it is a matter of the greatest interest and of no small satisfaction to ourselves that oil injection into the vessel preceding the catalyst vessel has now been adopted on every type of oil gasification plant of which we have knowledge.

Four runs over periods of several months with modifications in operation and other conditions are described in detail. Results are given in Table 4.

In work such as that described some of the data are capable of more than one interpretation. There is, however, complete agreement amongst those associated with the project that the decision to inject all the oil into the steam preheater and none on to the catalyst was the greatest factor in leading to what success has been achieved.

The plant has a nominal capacity of 1 mill. cu.ft. per day from gas oil of low C/H ratio but, although gaseous yields vary inversely as the C/H ratio, production of that order has been obtained with oil of high C/H ratio.

Temperature Stresses

The three-vessel design of steam preheater and separate catalyst vessel and air preheater has facilitated experimental investigation of the process. The steam preheater serves a most important function. Fuel oil is pumped to it with sufficient preheat (minimum temperature 195°F. for 950 secs. oil) to allow effective atomisation. The rose type of spray has been efficient in producing a finely divided cone of oil. During its passage through the chequer work process steam must be raised to a temperature sufficiently high to ensure that the oil sprayed into it is vaporised and the steam/oil mixture has the least possible cooling effect on the catalyst. The free space above the chequers must be such that the top course intercepts droplets at the periphery of the oil spray cone and prevents oil impinging on the walls. The firebrick chequers used are liable to damage by sudden changes of temperatures. Their replacement by material of high refractoriness such as carborundum was considered but the suggestion was not proceeded with when it became apparent that a great proportion of the damage was caused by oil ash of relatively low fusion point. The ash forms a thin sheet which binds the chequers, but there has been evolved a technique of removal and replacement which can be carried out during a week-end shut down.

The removal of a third of the chequers from the air preheater to leave more sensible heat in the gaseous products suggests that the air preheater is larger than need be. This view has been adopted in more recent designs where the air preheater is in effect a lower compartment of the catalyst vessel. The proposed experiments on P.F.D. may, however, tend to modify this view.

In the first run both large and small rings were used, the tar produced was thin and smoke production was small, but the temperature distribution was poor and it was felt that too much catalyst was present. Only large rings were used at the beginning of the second run. This more than corrected the temperature distribution but less carbon was retained and more passed through the plant and appeared in the tar. The catalytic activity of the bed was low, the C.V. of the gas tended to be high and tar was very viscous. Small rings were added suc-

cessively to remove the difficulties encountered until the quantity of catalyst present was sufficient to produce gas of the desired quality without using temperatures which would in themselves have given rise to viscous tar. The third run began with another combination of large and small rings to which further additions of small rings were made.

At each removal of the catalyst the broken material has been about 12% of the total but includes breakage by handling. At the next emptying of the catalyst vessel it is intended to take out the catalyst in shallow layers for close examination when the extent of fracture in actual service can be determined.

The activating effect of the catalyst has been shown to be in close relation with the catalyst surface area and can be controlled by suitable combinations of large and of small rings.

The fuel oil received is of mixed origin with a moderate paraffinic content. Its characteristics have been within the limits shown in Table 3.

TABLE 3

	Lower Limit	Upper Limit	Average
Viscosity	717 secs.	950 secs.	925 sec. Redwood No.1 at 100°F.
Specific gravity	0·951	0·969	0·958
Conradson carbon ..	9·7	10·9	9·4
Carbon	84·9	85·1	85·0
Hydrogen	10·8	11·1	10·9
C/H Ratio	7·65	7·88	7·73
Sulphur	3·4%	3·7%	3·6%
Ash	—	—	0·02%

The gas analyses, when compared with the composition of gases produced by thermal cracking, whether in steam or not, show effective catalysis of the reactions, and differ from coal gas chiefly in a higher CO_2 content and a higher specific gravity. There has normally been 9-11% of CO_2 with a slight tendency to increase as the catalyst has become older, but on isolated occasions figures as low as 4% and as high as 17% have been observed. Reduction of process steam and of the steam/oil ratio have not caused corresponding reduction in the CO_2 content. Conversely the use of high steam rates did not increase the yield of gas. The optimum conditions for minimum CO_2 production are not yet understood and it would appear that the value of the catalyst would be increased and the process improved by the incorporation in the catalyst of substances specifically designed to promote the steam/carbon reaction at a relatively low temperature.

Sulphuretted hydrogen in the crude gas with an observed maximum of over 600 grains per 100 cu.ft. is comparable with that in crude coal gas. Organic sulphur compounds have been present in varying quantity, average figures for the four runs being:

Run 1, 14.5; run 2, 35.4; run 3, 45.7; run 4, 10.8 grains per 100 cu.ft.

Some connection with the throughput of the plant is possible. There has been no evidence of a relationship between the amounts of H_2S and organic sulphur present at the same time. The variations in content are explained by the fact that the bulk of the sulphur in the oil is retained by the catalyst during the make period of the cycle and small differences in the amount passed forward produce large differences in content in the crude gas.

When naphthalene has been present to the extent of more than a few grains per 100 cu.ft. it has been taken to indicate too high a temperature at some point in the catalyst bed and adjustments have been made. Nitric oxide has usually been absent; the maximum observed has been two parts per mill.

The overall amount of effluent to be disposed of is small, although from day to day there are surpluses or deficiencies in the total amount of water in circulation according to the volume of process steam used and the atmospheric and other conditions affecting the water-cooling tower. Analyses of the water have shown H_2S and sulphides to be absent and that other soluble substances accumulate very slowly. A notable characteristic is the tendency to acidity, as pH values less than 4 may be reached unless counteracted by the regular addition of alkali. Ammonia liquor was first used as being convenient and readily available but its use was soon discontinued to be replaced by soda ash as giving reasonably inert solutes and having no deleterious action when the circulating water is finally discarded.

The volume of effluent to be disposed of to maintain stable conditions was determined in a series of experiments in November last when the effluent run to waste was stringently controlled for a period of four weeks. Oxygen absorption figures for various rates of disposal indicate that equilibrium would be attained with a disposal rate of nearly 2 gal. per 1,000 cu.ft. The O/A and BOD are very satisfactory and compare favourably with an oxygen absorption figure of 10,000 p.p.m. for present-day spent liquor or a BOD of 500 for ordinary sewage.

Heavy fuel oils contain vanadium which becomes concentrated in oil ash. Since vanadium is toxic its presence is a matter of most serious concern to all who have contact with heavy fuel oils or fuel oil ash. A quantity of fused material from the top of the catalyst bed was separated into a brown encrustation and body material. Samples of oil ash gave the vanadium oxide contents shown below:

Ash from top of steam preheater	3.64
Ash from base of steam preheater	3.69
Sample of catalyst from top of bed	1.85

The third sample was derived from catalyst rings and inevitably contained a proportion of catalyst material. The concentration of vanadium on the surface is at least ten times greater.

I am indebted to Dr. E. C. Fear, Chief Medical Officer, N.E.G.B., for the basis of the following notes. The toxicity of vanadates was recognised and its effect on frogs was studied by Gamgee and Larmuth as long ago as 1877. The symptomatology of vanadium poisoning is well known and easily recognised. It includes greenish-black discoloration of tongue and teeth and a metallic taste in the mouth; irritation of nasal and throat passages with sneezing and a dry irritating cough; slight gastro-intestinal disturbances; possible skin irritation of regions of pronounced sweating. These effects had previously been thought to be due to V_2O_5 forming an acid solution in water but they are much more likely to be due to vanadium as vanadate. In the oxidising conditions of combustion there will be produced the pentoxide which, being amphoteric, will combine with the basic materials of the catalyst and refractories to form vanadates. The symptoms clear within 48 hours of withdrawal from the toxic atmosphere except for discoloration of the tongue and teeth which persists for four or five days. Routine clinical examinations have shown no residual physical signs and chest X-rays are all negative.

Protection provided

Adequate protection is provided for all workers who are in any danger of exposure to oil ash dust. They are supplied with full boiler suits secured at wrist and ankles and with gauntlets and gumboots. They wear a polythene hood completely covering the head and face and fastened to the boiler suit at back and front by press-studs. The plastic hood has a transparent window at the front and a fitting at the back for the attachment of an external airline. Air under suitable pressure circulates inside the hood and escapes from the press-studded margins under pressure sufficient to prevent ingress of dust. Since the introduction of these protective measures used catalyst, chequer brick, oil ash and dust have been removed and handled on a number of occasions without the occurrence of any untoward symptoms.

Results of special significance have already received mention. The statistics presented in Table 4 cover continuous periods ranging from 61 to 160 days. No allowance has been made for the fact that the plant has operated under experimental and abnormal conditions, and the data may justifiably be said to represent in most respects the minimum potentialities of the plant.

TABLE 4.—SUMMARY OF YIELDS, ETC.

Run	I	II	IIIa	IIIb	IV
Days worked	61	128	160	84	123
Gas made: 1,000 cu. ft.	20,381	85,615	106,802	46,370	78,924
Therms	95,790	407,737	516,217	223,451	394,760
C.V.: B.Th.U. per cu. ft.	470	476	483	482	500
Oil used: gal.	78,860	326,624	423,841	196,923	325,372
Therms per gal. oil	1·215	1·249	1·218	1·135	1·213
Heating gas: % of therms made	16·77	8·89	5·19	7·99	6·18
Steam used: lb.	1,776,000	5,927,120	5,708,080	2,781,920	4,784,860
lb./1,000 cu. ft.	87·1	69·2	53·4	60·0	60·6
Dry tar made: % of oil used	12·72	11·54	12·72	17·85	14·92
Soda ash used: lb.	—	9,050	13,305	6,485	9,700
Wetting agent used: gal.	—	25·87	53·26	23·63	45·38

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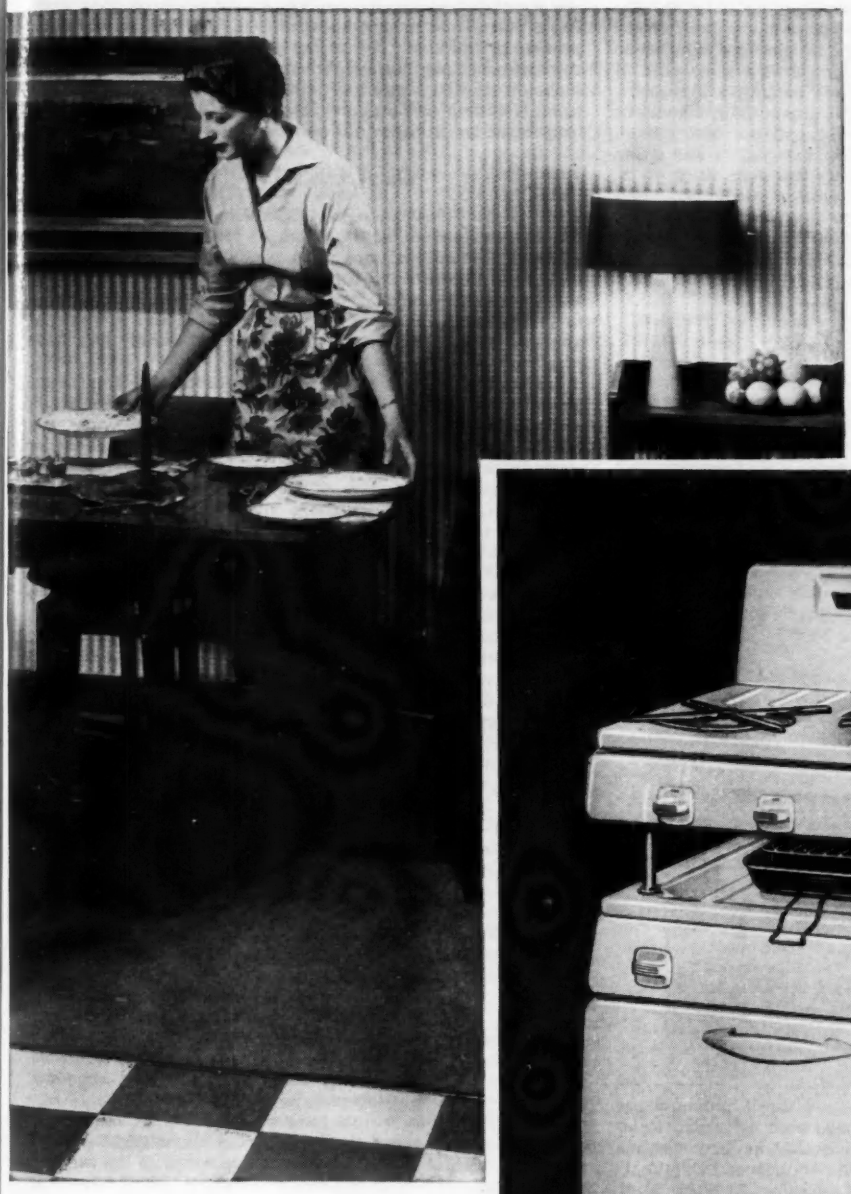

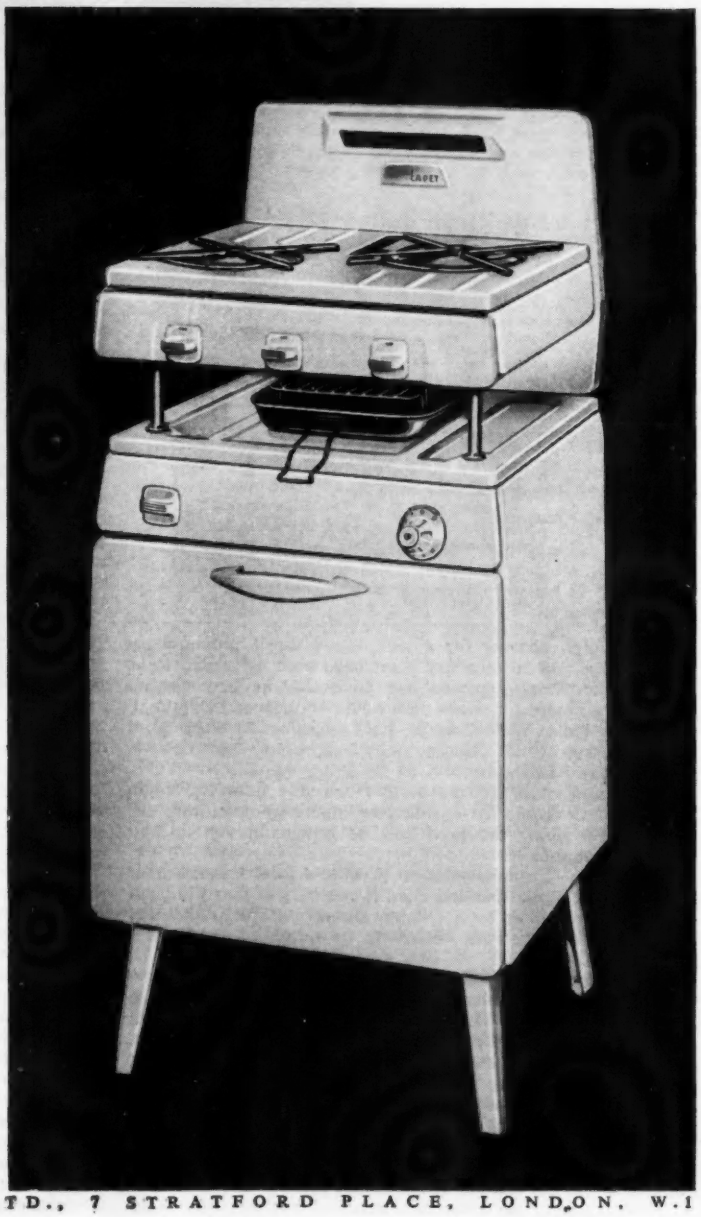

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Conditions of operation have been established which indicate that in normal operations the plant, using heavy fuel oil 950 secs. Redwood No. 1 at 100°F., should produce 900,000 to 950,000 cu.ft. per day of 500 B.Th.U. gas at a gross yield of 1.25-1.27 therms per gal. of oil or, if heating gas at 5-6% be deducted, a net yield of 1.20 therms per gal. There would be produced a thin tar equivalent to 12 gal. per 100 gal. oil and having a water content of approximately 5%, and steam consumption would be almost certainly less than 40 to 45 lb. per 1,000 cu.ft.

Recorded costs of production are not true normal costs because of the experimental operation of the plant. Price changes for heavy oil delivered to the works have been:—

July	1954	8.625d. per gal.	100.0
September	1955	9.125 „	105.8
June	1956	9.55 „	110.7
October	1956	10.05 „	116.5
December	1956	13.55 „	157.1

Events in the Middle East in the latter half of 1956 have completely distorted the economics of oil gasification and emphasise the importance of the projected experiments on P.F.D. The costs in Table 5 are therefore shown for two prices of oil: (A) The price which would have been operative but for recent events, and (B) the present price, which includes a total uplift of 4d. per gal. The costs are also based on the more conservative of the ratings given in the last section and estimate 75% annual load factor, say, 280 days, production per annum.

Table 5

		Pence per therm	
		A	B
Oil	1·25 therms per gal. of oil	7·640	10·840
Tar	Less 0·096 gal. dry tar at 11·70d. per gal.	1·123	
		6·517	9·717
Heating gas	0·06 therms at 12·0d. per therm	0·720	
Steam	9·0 lb. at 8s. per 1,000 lb.	0·864	
Electricity	50 units per hour at 1·02d. per hour	0·272	
Labour	4 shift operators (allowing for sickness, holiday relief and maintenance duties during shut-downs) at 34s. 3d. per shift +10%	0·522	
Chemicals	Soda ash: 112 lb. per day at £12 1s. 3d. per ton	0·032	
	Wetting agent: 0·4 gal. per day at 74s. per ton	0·079	
	Anthracite oil: 17 gal. per day at 1s. 8½d. per gal.	0·077	
Catalyst	Complete renewal every 2½ years at £1,600	0·122	
Repairs and maintenance	Estimated	0·500	
General works charges	Including purification	0·550	
		3·738	
	Net cost of production	10·255	13·455

The capital charges for a complete plant including waste heat boilers and all ancillary plant have been calculated to be 0.682d. per therm at present-day prices, but in these circumstances the charge for steam used would be reduced by approximately a half. Where, as at York, existing ancillary plant can be used, capital charges will be correspondingly less, in suitable cases falling to 60% of the figure quoted.

It is anticipated that the more favourable ratings given in the last section will be equalled or improved upon with the effect of reducing the total cost of production by at least 0.3d. per therm.

This paper is not intended to provide a final assessment of the plant at York. Nevertheless, it can be said that the plant has been proved to be a reliable gasmaking unit, sufficiently flexible in operation to contribute its quota to works production.

The programme for the future will include experiments on the maximum production obtainable from the present catalyst which at December 31, 1956, had already been under heat for 750 days and had produced over 1.63 mill. therms of gas. The gasification of P.F.D. will be carried out at the first opportunity following which investigations will be continued on the influence of methods of catalyst packing. Reference to possible modification of the constituents of the catalyst to secure greater activation and of the size of the rings has already been made. The incidence of sulphur compounds and of CO_2 in the gas will be further examined.

These projects are essentially practical but they also hold the possibility to enlarge our knowledge of the process itself for a more fundamental knowledge of the mechanism of the process is desirable. Given the proportionate constituents of the fuel oil as paraffins, naphthenes, aromatics and unsaturates, it should then be possible to control the course of the reactions towards certain end products, e.g., by inducing polymerisation to gaseous or near-gaseous aromatics.

DISCUSSION

Mr. J. H. Johnston, O.B.E., Chief Engineer, N.E.G.B., said the Sydenham plant went to work 15 months before the York plant and, with the information made available by the S.E.G.B., it was possible to anticipate troubles likely to be encountered and to prepare accordingly. While Mr. Nicholls had referred to the exchange of information with the S.E.G.B. it would be appreciated that independent thought and action had been preserved.

On first reading the paper, which added considerably to the published knowledge on oil gasification, one's impression might be that the plant was a problem child. That was true, but only in so far as it had not yet revealed all its secrets or even obtained optimum performance. The plant had been deliberately worked under different conditions and solutions had been found for most of the practical troubles that could arise. It was regarded by the works staff as a reliable gas-making unit, to be put on and taken off as might be necessary and to make its quota of town's gas without any more trouble than an established C.W.G. plant. Prior to its completion it was anticipated that serious troubles with viscous tar, naphthalene in quantity and an effluent problem, would have to be contended with. In actual fact (as Mr. Nicholls had shown) it was possible in day-to-day normal running to make gas virtually free from naphthalene and to produce a thin tar as acceptable as coal gas tar.

The outstanding expression, to Mr. Johnston's mind, was that optimum performance and freedom from troubles were wholly dependent, in the first place, on being able to control the level of temperature in the catalyst bed and the maintenance of such levels without exceeding anywhere temperatures in excess of a 950°C. He was convinced that was true and fundamental. The main contributory factor to the success which had been attained in that direction was undoubtedly the early decision to inject oil at the steam pre-heater top for vaporisation and admixture with steam prior to entering the catalyst chamber and not to spray oil direct on to the catalyst bed as originally intended.

Temperature Control

Mr. Johnston continued:—'A study of the operational data and accounts covering the four runs provides ample evidence of the virtues of temperature control and the evils attending departure from upper temperature limits quoted.

'On sulphur, area boards have been advised by the Chairman of the Gas Council that no new gas manufacturing plant should be installed without provision for reducing the sulphur content of gas below ten grains per 100 cu.ft. The nearer it is possible to get to this figure with normal operation of gas plant, the less will be the need for special sulphur reducing plant.

'Referring to figures for organic sulphur content of gas over the four runs, Mr. Johnston said he believed the lowest figure was about ten grains and the highest over 50 grains. If the sulphur in oil was more or less constant what was the reason for such wide variations of organic sulphur in the gas? Mr. Nicholls said it might be in connection with variations in throughput. He also stated there was no evidence of a relationship between the amount of H_2S and organic sulphur present at the same time.

'I cannot reconcile a variation of between ten and 50 grains with such reasons,' said Mr. Johnston. 'I am inclined to the view that there is a connection, and moreover controllable, and that it is possible to produce gas with a low average sulphur content. Is it not likely that there is a shift reaction CS_2 to H_2S at the catalyst surface, temperature being the controlling factor?

'It would appear that generally low organic sulphur content is consistent with low average temperatures, but this is not wholly conclusive. If a shift reaction did take place, one would expect low organic sulphur with high H_2S and vice versa. Unfortunately, average H_2S content for the runs is not quoted.

It would be desirable to carry out a sulphur balance under varying temperature conditions. It is possible that proper temperature control in the catalyst bed will reflect most favourably on this aspect of sulphur content of the final gas as well as securing all the desirable features of operation mentioned by Mr. Nicholls.

'With regard to steam, Table 15 quotes steam requirements of 9 lb. per therm of gas made, which at 500 C.V. equals 45 lb. per 1,000 cu.ft. of gas made. This is appreciably less than the average steam requirements quoted in the operating data. I think Mr. Nicholls is right in believing that 45 lb. per 1,000 cu.ft. can normally be attained and maintained.

'In the third run, the average steam consumption is 48.5 lb. against 70 lb. per 1,000 for the first two runs. It is significant that reverse blowing was introduced in the third run and this, no doubt, contributed to reducing steam requirements. Reverse blowing has three main objectives—prevention of heat drift with more positive control of temperature distribution; lower steam consumption; and lower CO_2 content of the gas. Back blast air is introduced at the top of the steam preheater immediately following the run period. It replaces purge steam and reduces the steam/oil ratio. It offsets the chilling effect of forward blow on the air preheater and reduces accumulations of deposits in the air preheater. Tar is appreciably thinner. Although reverse blowing lengthens the cycles and reduces output per unit of time, the plant can be run over longer periods by reducing the time taken for burning off in preheater.

'I believe it will ultimately be possible to operate efficiently with a steam consumption of 35 lb. per 1,000 cu.ft. or even lower. It is also expected that with a lower steam/oil ratio there would be a reduction of the CO_2 content to something appreciably less than the 10% now obtained.

More Information Required

'More information is required before full optimum performances can be realised. After the proposed trials gasifying P.F.D. and with a charge of fresh catalyst, no doubt efforts will be made to continue investigations with the object of realising all that is thought possible of the plant, i.e.—in respect of gas output and quality, low steam consumption, lower sulphur and lower CO_2. It would also be desirable to obtain more information on the two major cracking variables, temperature and time. The net therms of gas per gallon of oil gasified over the year 1955/56 was 1.15, which, while being reasonably satisfactory, can be improved upon.

'I have no doubt this type of oil gas plant will play an increasing part in the gas industry's development, especially in satisfying that section of the load which is variable. Already a number of plants both large and small are under construction. Provided oil prices recover when supplies once again become normal, relatively cheap variable and interruptible load gas will be possible—without the use of coke. I congratulate Mr. Nicholls on an excellent and informative paper containing valuable data.'

Mr. Nicholls said he would like to see the temperature kept at below 950°C. but they came to the question of velocity of the gas. It could be taken too high. On the relationship of sulphur, H_2S could fit into anything variable on the plant and he agreed there appeared to be what one might call absorption of sulphur on the surface of the catalyst. They had not established there was a relationship between H_2S and sulphur dioxide but that there was a relationship only with a given set of conditions. It did not follow they would see a relationship until they knew all the conditions.

Mr. J. B. McKean said the record of long periods of continuous working of the Segas process made fascinating reading. It was reassuring to hear that Mr. Nicholls, too, considered that the plant could be said to be a reliable gas-making unit, and indeed it must have been thought so when it was kept at work when they were threatened with a coal strike. The results obtained fulfilled early promise.

He noted specially the suggestion that the 'value of the catalyst would be increased and the process improved by the incorporation in the catalyst of substances specifically designed to promote the steam/carbon reaction at a relatively low temperature.'

'I would remind Mr. Nicholls that alkalis and alkali earth metals are well known as catalysts for this reaction and the use of lime as the catalyst was chosen as being the one most likely to be a robust and permanent catalyst. Other catalysts for the reaction, particularly in the presence of sulphur, have from time to time been claimed, but these claims have not withstood rigorous scientific examination.

'The suggestion, too, has been made that larger rings might be advantageous in reducing back pressure. While this might to some slight extent do so, the loss of surface with larger rings would require to be made up by using a greater depth of bed and the gain would be slight. The important factor in pressure loss in the catalyst vessel is not the catalyst bed, but the free cross section of the grate supporting the bed and particular attention must always be paid to this in the design stages. It is a comforting thought that at York the experiments with various packings in the catalyst bed suggest that the original surface specified has not been too far adrift.'

As to the effects of ash from the oil and possibility of poisoning by vanadium, Mr. McKean said efforts directed to greater safety were always praiseworthy but such efforts could be carried to extremes which became ridiculous. It was wise to pass a balanced judgment upon risks involved in a piece of work. The dreadful symptons arising from exposure to vanadium, enumerated by the Chief Medical Officer, North Eastern Gas Board, he suggested, were not worse than a mild digestive disorder. In his Board men had for some time been required to handle material which had been impregnated with oil ash but none of the suggested symptoms had been experienced at any time. The advice of their own Medical Officer was that the normal precautions to be taken in the repair of silica work in settings were quite adequate.

It was interesting to note that at York proposals were afoot to use light petroleum distillate and he was sure they would do so with equal success. Experience at Sydenham had shown that P.F.D. could be gasified to a 500 B.Th.U. gas with an efficiency, after allowing for auxiliary heating of the plant, of almost 80% and the gas produced had all the characteristics of coal gas without the disadvantage of high CO_2.

Mr. Nicholls, in reply, said quite obviously lime was a reactive catalyst but he thought the larger ring would be beneficial. What worried him about these rings was that 'one looked like big titch and the other like little titch' and that there was loss of surface activity.

Dr. G. Milner, of the Power Gas Corporation, said Mr. Johnston had apparently made up his mind that he would like this plant at York even before the pilot plant at Old Kent Road was put to work and before the prototype at Sydenham was designed. He had a lot of hard work to do in persuading the Board and this was an example of considerable courage in pushing the development of a new process.

The unit at York was really a prototype. It was a three-vessel unit and was designed that way because the South Eastern Board, and his firm's design staff, came to the conclusion that it would give a greater degree of adjustment whereby experiments could be made to find out how to operate the process to the best advantage. Emphasis was on the gasification of heavy oil.

Two-type Vessel Preferred

Subsequently they came to the conclusion that in order to meet competition and maintain output of the plant with the lower capital cost it would be better to design it as a two-vessel type. It was interesting to note that a two-vessel unit of about the same rate of capacity as York had been tested by the German Gas Institute. It was reported that it had fulfilled all the claims made for it and had successfully gasified much heavier oil and had achieved a net yield of 1.25 to 1.26 therms per gall. It had successfully gasified brown coal tar and obtained similar efficiency.

Since the design of a two-vessel unit, interest had swung towards x-y-z, or low grade petrols. It became clear when experiments with that type of material began at Sydenham that a three-vessel unit had definite advantages. There was a marked difference from the behaviour of like fractions and that was different to deposit carbons in the catalyst bed. Consequently with a material that would not deposit carbon one had to provide auxiliary heat. It was easier to supply heat to the catalyst bed from below. The two-vessel type was cheaper than the three-vessel type and was perfectly successful.

Proposing a vote of thanks to Mr. Nicholls, **Mr. J. G. Tilley,** Junior Vice-Chairman, strongly suggested that the paper was worthy of presentation to the Institution of Gas Engineers, the parent body.

The early part of the paper, he said, gave them a refresher on organic chemistry, a subject with which many of them tended to get a little out of touch, but which was, nevertheless, fundamental to a proper understanding of the working of a plant of that type. Whatever would be the outcome of political and economic events on oil prices and availability there were several sets of circumstances in the industry under which oil gasification could be justified. The need to conserve coke supplies to meet the anticipated expanding market might well be such a case and it might also offer prospects for economy in manufacturing costs in the smaller districts which were too far away from a larger works to justify a bulk supply.

'It is evident,' said Mr. Tilley, 'that the oil gasification process is likely to offer substantial advantages particularly at the higher C.V.'s. Whatever may be the functions that these plants are best suited to serve in the future, Mr. Nicholls's paper makes a valuable contribution to the store of knowledge on oil gasification.

From a paper to the London and Southern Section of the Institution on March 19.

Contractors' Delivery Promises and their Fulfilment

By I. H. PHILLIPPS, M.A., M.I.C.E.,

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FOR the first few years after the war the proper planning and co-ordination of major contracts was impossible. Manufacturers of proprietary equipment had full order books and could only offer long and uncertain delivery dates. With steel rationing in force and a general shortage of skilled staff, new contracts had to join the end of a long queue with the result that completion periods were as long as three, four, or even five years.

However, the situation has now much improved and overall times have been reduced to less than half. For the last eighteen months there has been a period of relative stability so that it is now possible to present a much clearer picture. It is the purpose of this paper, therefore, first to describe the course of a large contract through a typical contractor's organisation and then to discuss those factors which are found most frequently to cause delay.

Through all the stages to be considered—negotiation, design, manufacture, and construction—I propose to treat the contractor's sales engineer and his opposite number, the client's planning engineer, as siamese twins. As far as the main contracting decisions are concerned, these two have to sort things out between themselves. As soon as an enquiry is sufficiently defined the sales engineer discusses it with the planning engineer and gives him the fullest possible description of what is wanted. Clearly, the more complete this description can be the better will be the estimate of delivery time. The planning engineer has then to consider all the various chains of events which would have to take place through design, drawing office, works and site; and from among these he has to pick out the pace makers. His work is, of course, greatly shortened by experience but in principle he has to go through certain basic steps:

He must keep in his possession an up-to-date record of approximate delivery periods from manufacturers for all usual items. Special equipment has, however, to be considered for each project. For any item a number of things have to be done before it can be ordered and a number of things have to be done after it is delivered to site. A series of overall delivery periods for possible pacemakers can be arrived at. Two examples of these are shown in Fig. 1.

The second example in the figure shows how long a time is spent waiting for drawings of suppliers' proprietary equipment and I would stress this particularly since it is a matter which we are finding to be one of the most difficult.

The time indicated is an average but it is often very much longer because the maker of proprietary equipment naturally tends to think of it as part of his own production programme and to make the various drawings required for it by dates determined on that basis. It is difficult for him to see it as part of a large installation and to realise how many things and how many other people may be waiting for his information. In fact, progress on foundations, pipework, platforms and even instruments and electrical work can all be held up for lack of details of equipment from one manufacturer.

With the longer delivery period, from Fig. 1 as an example, it might be regarded as the minimum time for the completion of the contract but it assumes that on the day the order is placed there is available in the contractor's office design and drawing office capacity for work to begin forthwith. Such a situation would of course be most uneconomic; so the work load before a drawing office must be considered next to determine when the new work could be begun.

In assessing a new project experience makes a reasonably accurate assessment possible of the hours required and this can quite simply be related to a work load curve, but unfortunately two major complications arise. First, the man hour requirements of a contract are not evenly spread and, second, drawing office staff cannot be regarded as all the same and interchangeable. This does not merely mean that some are good and some are not so good, but that draughtsmen are specialists and as this trend of specialisation is getting more and

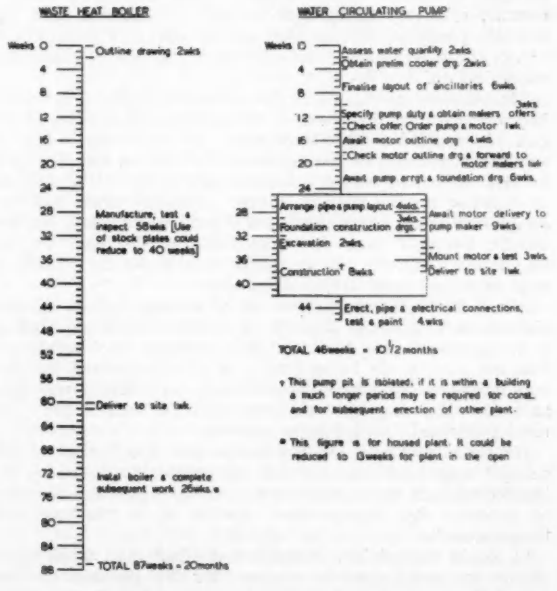
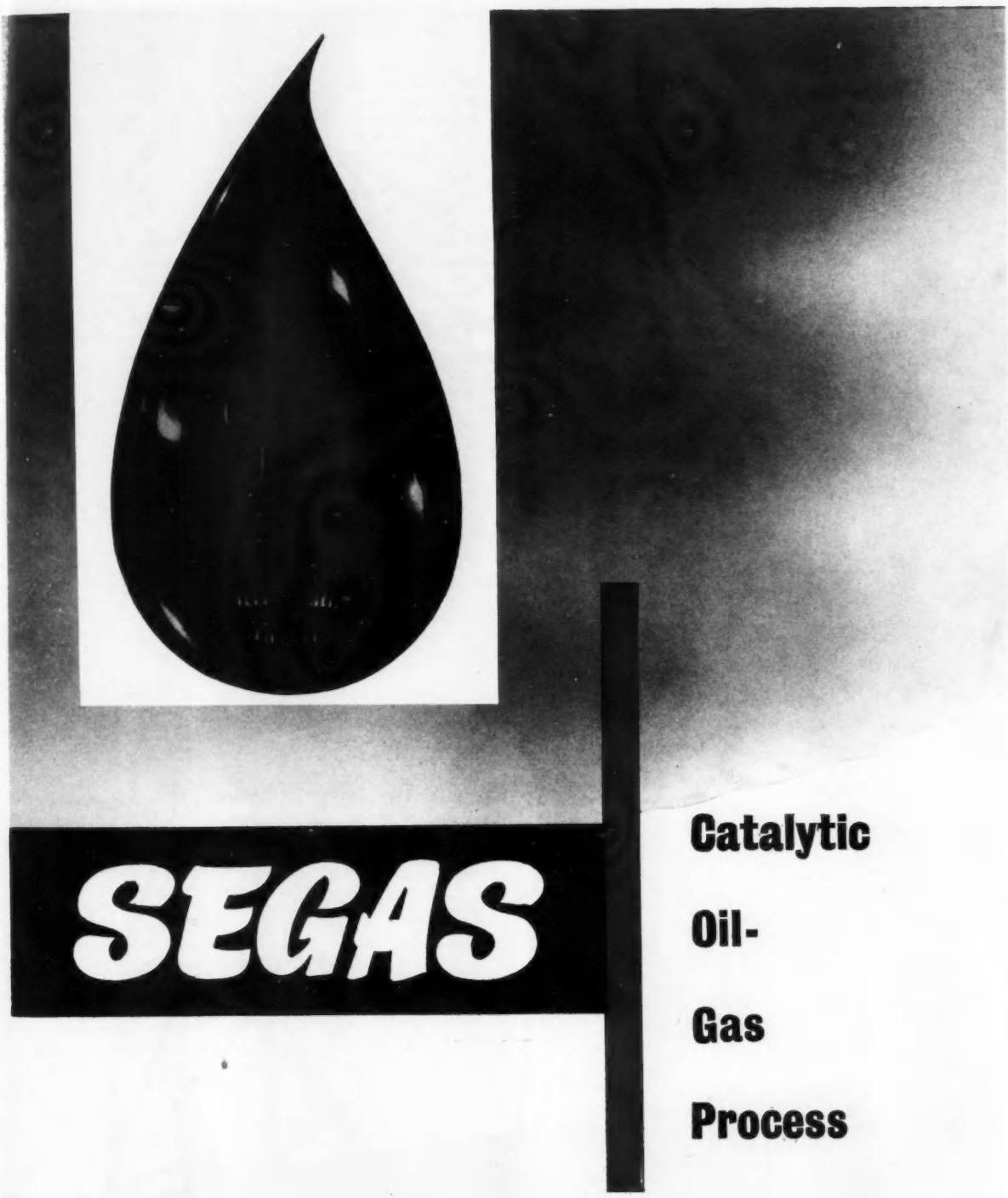

WASTE HEAT BOILER
Weeks 0
Outline drawing 2wks
Manufacture, test & inspect 58wks [Use of stock plates could reduce to 40 weeks]
Deliver to site 1wk.
Instal boiler & complete subsequent work 26wks.*
TOTAL 87weeks = 20months
WATER CIRCULATING PUMP
Weeks 0
Assess water quantity 2wks
Obtain prelim cooler drg. 2wks
Finalise layout of ancillaries 6wks.
Specify pump duty & obtain makers offers 3wks
Check offer Order pump & motor 1wk.
Await motor outline drg. 4 wks
Check motor outline drg & forward to motor makers 1wk
Await pump arrgt & foundation drg. 6wks.
Arrange pipe & pump layout 4wks.
Foundation construction drgs. 3wks.
Excavation 2wks.
Construction† 8wks.
Await motor delivery to pump maker 9wks
Mount motor & test 3wks.
Deliver to site 1wk.
Erect, pipe & electrical connections, test & paint 4wks
TOTAL 46weeks = 10½months
† This pump pit is isolated, if it is within a building a much longer period may be required for const. and for subsequent erection of other plant.
* This figure is for housed plant. It could be reduced to 13weeks for plant in the open

Fig. 1



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more pronounced as new techniques are introduced, there are very few men nowadays who can be moved efficiently from one section to another, for instance, from refractories to piping or from boiler design to structural steelwork.

Before the planning engineer can give his information it must be remembered that a contractor cannot afford to bid for a contract without considering its spread over the various design and drawing office sections and he may have to decline to tender for projects which might put his work load out of balance and even after the planning engineer has arrived at his assessment, he must then decide whether to 'weight' it for special requirements. These might be the approval by the client of all drawings or, in the case of a hurried tender, an allowance for the inevitable correction of assumptions which have had to be made on account of lack of information.

Several months may elapse between the date of tender and date of order and in the meantime the contractor will have sent out a number of other tenders and may well have committed himself to work which affects his earlier estimate of delivery. This must now be reviewed and either confirmed or adjusted.

At this stage, in most contracting offices, a change takes place in the organisation and a project engineer is appointed to co-ordinate and expedite the subsequent work since it is necessary, at all stages, to have a good system of progress measurement to be certain that the work is being completed as scheduled. Promises from manufacturers must be made by people who can and intend to keep them, but even so, if there are any doubts they must be followed up in person while there is still time in hand. Expeditors, who deal with suppliers for this purpose, must be men with personality, who can get things put right at management level.

After acceptance of the tender, it should only be necessary to follow the plan and, provided nothing goes wrong, the contract is duly completed on time. This is not just a pious hope and, where things have been properly thought out, it is achieved more often than not, but unfortunately, for one reason or another, something may go wrong and a contingency factor is always included to allow for a reasonable amount of reconsideration. Fundamental changes of thought, which cause the real difficulties, do occur far more often than either client or contractor would like to admit and such changes include the type of plant, the site and changes in the conception of associated ancillaries.

Drawing Office Time

A drawing office load curve for a recent contract in which both the basic type of plant and the arrangement of ancillary plant had to be reconsidered to suit revised requirements, shows the long initial period and the overall time spent by the drawing office and the very late commencement of erection caused by the slowness of construction of the client's foundations. It took 26 weeks before construction of the plant started.

Major changes such as this are very difficult to accommodate since the contract uses up not only its own contingency factor, but also those of other contracts, so that their completion times are prejudiced. The clients of these other contracts can hardly be expected to accept the situation cheerfully.

The rearrangement of ancillary plant is a most frequent occurrence because the client's requirements in this are not so often specified in full and the matter is left initially to the discretion of the contractor. He has to submit a competitive tender and he probably puts forward the simplest possible design. Later when the client considers this he may decide that additional capital expenditure would be justified either to increase operating efficiency or to suit special circumstances such as the need to limit the quantity of difficult effluent. The whole question has then to be reopened.

A further difficulty is incorporation by the contractor of subsequent improvement in his standard designs. Most clients are human and seem to expect to have all new developments thrown in and since the sales engineer does not like to disappoint his clients, the inevitable result is change and delay quite apart from any alteration in cost.

While such fundamentals as these are still under consideration, no real start can be made, no plan can become operative and no promised delivery period can begin. In major contracting work carried out in the U.S.A. completion dates usually start from the point of release. This applies primarily to 'costed' contracts, but it is equally realistic with 'lump sum' work and is the main reason why completion dates achieved by American companies are reputed to be substantially shorter than those of British companies. A typical definition of 'release' is the point when final approval of the following items has been obtained: Plant specification, flow diagrams, site plan giving the location of all major plant items, and approval of suppliers of all major items of equipment. It is not until this stage is reached that it is possible for preliminary orders to be placed for the greater part of the material required. Thus a curve for the drawing office and design work on a plant completed in 14 months, shows the point of 'release' to be three and a half months after the date of order. The completion period, American style, would, therefore, have been only ten and a half months.

Apart from the question of major changes, even the most innocent looking variations may involve a completely disproportionate amount of work. Table I gives a list of the drawings and other documents which would have to be altered or remade if, at a date some three months before erection, a client requested that a steam driven tar pump be omitted and an electrically driven pump be installed instead. At this stage there might well be nearly a year to run before the final completion date so to the client the request might not seem to be unreasonable.

NO. OF ALTERATIONS TO DRAWINGS, ORDERS, ETC. BROUGHT ABOUT BY CHANGE OF TAR PUMP FROM STEAM TO ELECTRIC DRIVE

(*Date assumed prior to issue of erectors' prints*)

	Layout	Pumping	Piping	Electrical	Civil	Progress	Total
Drawings ..	3	—	8	4	4	—	19
Bending Schedules	—	—	—	—	2	—	2
Requisitions	1	2	5	5	—	—	13
Orders ..	1	2	10	4	6	—	23
Prints ..	10	—	26x	28	39	—	103
Letters ..	4	4	3	10	9	11	41

Also : Internal Specification Correction Sheet (10 copies). Motor Date Sheet. Motor Test Sheet. Departmental Book Entries. Estimating Corrections. Progress Records, etc.

and : Suppliers correspondence, Programme Corrections, Advice Notes, Invoices, etc., corresponding to 23 orders.

TABLE II.
RECENT CAUSES OF DELAY.

In the drawing office.

1. Reconsideration of ancillary plant, particularly in respect of efficiency and effluent problems.
2. Acceptance of chimney height by Alkali Inspector and Local Authority; agreement of form of chimney construction.
3. Modifications for use of different feedstocks, e.g., heavy oil on C.W.G. sets; P.F.D. or refinery gas on catalytic oil gas plant.
4. Effect on amenities of neighbouring properties. Approval of Town and Country Planning.
5. Accommodation within plant buildings of additional equipment to be provided by client.
6. Late details of electrical equipment to be supplied by client.
7. Acceptance of electrical apparatus by Local Authority.
8. Additional plant, e.g., incorporation of waste heat boilers.
9. Rearrangement due to discovery of underground works.
10. Changed *shop* painting requirements.
11. High site water table.
12. Incorporation of second-hand material.
13. Change of site.
14. Flooding of drainage outfall.

On site.

1. Foundation difficulties, when undertaken under separate contract.
   (a) Late start by foundation contractor due to inadequate time allowance for placing of foundation contract.
   (b) Errors—particularly in the position of holding down bolts.
   (c) Foundation levels.
   (d) Ground water—particularly when pits are involved.
   (e) Lack of clean access for staff.
2. Late and inadequate provision of site services for construction or testing.

But to give a shorter overall period, or to speed things up once they have fallen behind at the various stages of the work, the following can all be of assistance.

Drawing office.—Additional drawing office staff made available; employment of superior draughtsmen with greater flexibility of techniques; use of highly paid temporary men.

Works.—Purchase of material from stockists; use of unusual suppliers; use of over-size machinery, materials and prime movers.

Construction.—Use of manpower greater than the economic level for the particular site; high percentage of staff men as opposed to local labour; use of special construction methods. (These points are small compared with the overriding importance of having material on site when required.)

General.—At each stage overtime may be worked or part of the work may be put out to sub-contractors.

All of these are expensive and many of them are also undesirable for other reasons. The possible disadvantages of overtime and sub-contracting are well known and to carry surplus staff creates difficulties because men do not like being idle. The use of over-size machinery is unsatisfactory because of the higher power consumption and contractors do not like to have their name on such apparatus. A high percentage of staff men on construction work is only practicable in a company which has a level work load.

But if a job is planned to a tight schedule and because of delay must somehow be pulled out of the fire by such methods as these, it is very expensive, but to give an exact account of such additional expenditure is usually quite impossible.

From the financial aspect, it will be helpful to try to put into perspective the fact that more has been said in this paper about design than about manufacture or construction. This is not because of the actual cost of design, but because of the influence which it has over what is done later. A typical rough division into the respective outgoings for the three fields would be in the ratio of 10:60:30. It is the two latter items which consume the greater part of the money, but we know from experience with 'lump sum' tendering that it does not pay to skimp the design for, any apparent saving here can easily result in a loss of two or threefold later.

So, when placing 'costed' contracts, it is important for a client to keep a close check on the design methods employed, and to know whether any design work is to be carried out by sub-contractors since this may well have the effect of reducing the apparent fee, but of increasing the total expenditure.

Nearly every enquiry asks for the lowest price and the earliest delivery. But this is a contradiction in terms and it would be to the interests of both parties if, wherever possible, the desired completion date was stated, for when a sales engineer is placed in such a predicament, he is tempted to hope for the best of both worlds. Quick tenders are likely to be high tenders, and will have to include special contingencies to cover assumptions, which of them depends on the previous experience with the particular client. Quick tenders are also likely to lead to slow deliveries because so many things remain to be discussed later and it always seems to take longer to change an assumption than to make a first decision.

The preparation of unused tenders and specifications is an expensive business but this is perhaps not its worst feature. To get a good scheme together requires the attention of the best specialists and although their work on contracts can be planned unfortunately on enquiries it cannot, since enquiries come at irregular intervals and the attention which they require can interfere seriously with contract work.

DISCUSSION

Opening the discussion which followed, **Dr. A. E. Haffner,** Chief Engineer, Southern Gas Board, said contractors had seen that the delay in delivery of one component by a manufacturer might jeopardise the completion date of their own contract. The contractor might be to the client just one part of a whole scheme involving many large contracts and the delay in one of them could minimise the effectiveness of the complete major project. If there were delay in attaining the savings for which the project was started, there would be an extension of the unproductive period carrying heavy interest and even depreciation charges, and a continued charge for operational personnel recruited and trained for the agreed date of production. It was not only a question of days' delay because delays become multiplied. In a recent example a few days' delay of a component too late for a phase in a tidal operation which needed an unbroken six weeks, caused the programme to wait till after the Christmas holiday, and after the week's holiday the tide was unfavourable for a fortnight. A few days' delay in delivery had involved seven weeks delay on completion.

Mr. Phillips had said lowest price could not be expected with quickest delivery, but he had never heard it suggested that a reduction in price could be had if needs were planned sufficiently carefully ahead for an extension in delivery time. An incentive not to make changes might be given by reducing the price for the contract which proceeded to completion without alteration, or if the contractor changing his mind, while accumulated experience from an earlier plant being licked into shape by another client, he might reduce the contract price.

While progress was being made in new fields such as catalytic oil gasification plants it was natural that the client should want to have incorporated into his plant any current improvements established elsewhere. It was no satisfaction to know that he had the most up-to-date obsolescent plant in the world.

Dr. J. Burns, Chief Engineer North Thames Gas Board, said Mr. Phillipps had provided a clear insight into the organisation required by the successful contractor and also an insight into the contractor's mind. The outstanding factor was the tremendous importance of the client knowing what he wanted before he approached the contractor at all. If he had only a woolly appreciation of what he wanted he could expect the worst of both worlds as the contractor was likely to put in a relatively high price to cover what he *thought* the client wanted and could then possibly find justification for charging extras when it was finally determined what the client should have.

Need for Precision

A quite precise specification should therefore be submitted to the contractor for full discussion before he was required to submit his price. Production of a clear cut specification did not imply that there was no room for the highly qualified specialists which the contractor carried on his staff. Indeed the reverse was true for collaboration between two men who really knew their job would achieve results worth more than double those likely if there were one-sided ability only.

A clear cut specification and price obviously represented the ideal, but the possibility of introducing improvements as the job went along had to be borne in mind; this was not impossible provided the effects of introducing them were appreciated. Here again, close collaboration between contractor and client was needed to determine the effects of the introduction of improvements on price, delivery time, and all other factors affecting the job. Above all, it called for somebody with iron determination who could—and would—say that from a certain point no *further* alterations should be made. This decision would be made when the effect of further improvements would be to reduce the overall economic efficiency of the scheme. A clear-cut specification and determination of variation led to a very much simpler job at the end of the contract when the time came to tot up the bill.

The method followed in the North Thames Gas Board for carrying out a major contract began with a determination for the need of a particular project centred on the Chief Engineer. A broad estimate of cost was then prepared, and if the project was seen to be right it was accepted by the Board. The Chief Engineer's Department then prepared a precise specification, calling for collaboration between all the design sections, including chemical, civil, mechanical, and gas engineering; the specification was then generally submitted for competitive tendering. At this stage there was every opportunity for discussion with the contractor on points of explanation and added definition until the contractor was quite clear what the client wanted and submitted his quotation. The quotations were studied in much detail to try to fathom any seen or unseen differences in offer until finally the successful contractor was nominated.

There was then much collaboration between the sucessful contractor and the various design sections of the Board to see that the job was progressing according to promise and plan; it was at this point that the possibility of variations were discussed. Here again, the same degree of precision was required, and each variation—if allowed—was predetermined and authorised by the Chief Engineer before the contractor

carried out the work, and invoices for the cost of these variations were accepted on the basis of the authorisation.

All this work was king-pinned in the Chief Engineer's Department but immediately construction started the centre of gravity shifted to the station and the Group and Station Engineer. They had attended all meetings and discussions and now took charge of the job, becoming immediately rsponsible for inspection, progressing, and all the other details of the contract. The impression might have been gained that delays through change of mind or circumstances never arose: This was not the case for all that could be hoped for was to minimise the effect of such changes on delivery times and costs.

Recalling Mr. Phillipps's remarks on lump sum and costed jobs, Dr. Burns said that where possible he favoured lump sum prices but the client must know his mind beforehand. The lump sum price implied a competitive price and called for keenness of perception on the contractor's part and the ability to put something forward of just that much better value than his competitor.

The client must be able to deal with 'Smart Alec' contractors—if they existed—who failed to keep their promises; the essential difference between the lump sum contract and the costed contract was that in the lump sum contract the client paid additionally only for his own mistakes but in the costed contract he paid also for the contractor's mistakes.

Client and contractor should enjoy reasonable collaboration and amicability; if they lived at daggers drawn it was a fairly sure indication that the client was not capable of dealing with the contractor.

Mr. C. Scott, Deputy Chief Engineer ,South Eastern Gas Board, stressed the length of time involved if a specification was to be prepared with real precision. As operators with operating experience, gas engineers were in a position to know and understand their needs, he affirmed. **Mr. R. F. Robinson,** Chesham Bois, said he appreciated that many of the factors leading to delays which Mr. Phillipps had mentioned could not be avoided if the best design was to be obtained, but he questioned whether there could not be standardisation of such apparatus as pumps, motors, and control gear. He felt, too, that there could be some measure of standardisation of drawings: If amendment details were issued separately, rather than waiting for draughtsmen to become available to prepare complete drawings, considerable time could be saved.

He had been surprised to hear Mr. Phillipps suggest that the client did not *normally* supply the desired completion dates with the enquiry.

Mr. K. H. Tuson, Consulting Engineer, questioned the specialisation of drawing office staff; their training he felt was not broad enough. Specialisation was a present-day curse which business organisations should refuse to accept; there should be wider scope for the individual.

Table I in the paper revealed too cumbersome an organisation, while many of the causes of delay given in Table II were avoidable. Some large organisations, he believed, had become unwieldy and suffered from inflexibility.

Mr. W. A. Evetts, Watford, felt that responsibility for liaising with the contractor should be delegated to one individual, while **Mr. R. E. Smith,** Sales and Projects Engineer, Humphreys & Glasgow, Ltd., complained of difficulties and delays arising from reluctance on the part of the Gas Board to agree over minor details.

Mr. J. M. Webber thanked Mr. Phillipps.

AMERICAN VIEWPOINT

Meter Diaphragm Leather Requirements

SPECIFICATIONS for meter diaphragm leather were viewed as largely impractical recently by an American Gas Association committee, because of the numbers of types and designs of gas meters used by the industry. The committee referred to the Draft of British Standards for East India sheepskin leather diaphrams for gas meters and said it 'applies to only one type meter design and, therefore, only one specific type leather diaphragm.'

Despite the negative viewpoint of the committee, it presented some rather broad and general requirements to allow for the various meter designs.

Regarding the raw product, it laid down that skins shall be fine-grained, soft, flexible, and of first-quality hair or wool-type lamb and sheep; free of holes, flaying defects and serious imperfections of fibre structure.

On shaving, it stipulated that skins shall be chosen so that only slight shaving to insure uniform thickness is necessary on the flesh side, followed by finishing without reducing original thickness excessively.

It further stated that skins shall be tanned by one of three methods, used for gas meter diaphragm material: 1, Bark tan, vegetable, to be used where resistance to moisture and heat is not important factor, skins to be thoroughly and uniformly tanned; no raw, untanned areas allowed. 2, partial chrome retan to be used if dimensional stability of bark leather is necessary and if resistance to moisture and heat is desired also, this method to be used if diaphragms are to be moulded or shaped; skins to be thoroughly vegetable-tanned and then retanned in basic chrome tanning salt having 0.7 to 1.0% chrome content. Leather to be neutralised after tanning. 3, chrome retan to be used where greater softness is required, as well as extreme resistance to moisture and heat. Same tannage as partial chrome, except chrome content, is to be 3.0% to 3.3%. Leather is to be neutralised after tanning.

The leather shall contain approximately 20% fat, made up of natural animal fat, No. 2 medicinal cod oil or neatsfoot oil and a light paraffin or mineral oil with a cold-test of zero.

These shrinkage temperatures are noted: Bark tan, at least 170°F.; partial chrome retan, at least 212°F.; chrome retan, boiling a 1 in. disc cut from piece of leather for five minutes at 212°F., with the disc refilling hole after boiling.

Under standard method of American Leather Chemists' Association, finished leather is to give these water extracts: Bark tan, pH value not lower than 3.0; partial chrome and chrome, pH value not lower than 3.5.

For obtaining correct thickness, the instrument is to be spring-type gauge with an anvil and presser foot of ¼ in. diameter and spring tension of 7 oz. or 200 grammes, as approved by American Leather Chemists' Association.

Leather for bellows-type diaphragm shall have firmness that will hold contour and shape, hold stitches, cement securely and be soft enough to operate under 8 oz. of pressure. Leather for roll or pan-type diaphragms shall be softer to roll without creasing but firm enough to avoid falling.

The most important leather characteristics, weight and degree of softness, cannot be measured by any known instrument, the AGA committee noted. Leather selection for each type of meter design must therefore continue to be a highly skilled and experienced personal procedure. They emphasised that most meter shops do not have either the technical equipment or personnel to conduct the tests that are used under stringent leather specifications. Further, the committee agreed, skin suppliers and diaphragm manufacturers have shown unquestioned integrity for many years.

Basic tanning processes have not changed for a half-century, indicating stability in the leather industry and the undesirability of having detailed specifications for tanning processes.

Detection of Benzene Vapour

THE Committee for Tests of Toxic Substances in Air of the Ministry of Labour and National Service, reports an error in *Methods for the Detection of Toxic Gases in Industry leaflet No. 4 Benzene Vapour* (second edition 1955), issued by the Department of Scientific and Industrial Research. In the standardisation of this test the table of concentrations given on p. 5 of the booklet should be revised as follows:—

No. of inflations of aspirator bulb.	Concentration of benzene (approx.) p.p.m.	mgs. per cm.
1	120	400
2	60	200
3	40	130
4	30	100
5	24	80
6	20	65

An amended table is to be issued by the Stationery Office and copies will be circulated to all purchasers of the apparatus used in conjunction with this test.

I.G.E. Midland Section Spring Meeting Discusses Dr. Dent's Research Paper

'EXPERIMENTS ON THE HYDROGENATION OF OILS TO GASEOUS HYDROCARBONS'

THE Spring Meeting of the Midland Section, Institution of Gas Engineers, was held at the Queen's Hotel, Birmingham, on February 15. Among those present was Sir Henry F. H. Jones, President of the I.G.E., who conveyed the greetings of the Council of the Institution and presented Institution Certificates to Mr. D. T. Amphlett, Mr. G. F. Lount, Mr. A. J. Reeve, Mr. E. E. Collins and Mr. G. C. Kent, and the M.A.G.E.M. Prize for 1956 to Mr. H. S. Smith, for his paper entitled 'Some Aspects of Mechanical Handling in the Gas Industry.'

Mr. J. Corrigan, Chairman, announced that Honorary Membership of the Institution of Gas Engineers had been conferred on Mr. R. J. Rogers, a Member of the Midland Section.

Dr. D. Hebden introduced the paper 'Experiments on the Hydrogenation of Oils to Gaseous Hydrocarbons,' which was first presented by Dr. F. J. Dent at the 22nd Autumn Research Meeting in November, 1956. The subject was very well illustrated, first by Dr. Hebden, and later by Dr. F. C. Wood, with the help of slides.

Dr. Hebden said: 'This Paper describes an investigation of the production of gaseous hydrocarbons by the hydrogenation of petroleum oils at pressures up to 50 atm. and temperatures between 700° and 900°C. Crude petroleum, heavy fuel oil and distillates have been used. The purpose is to develop oil hydrogenation as a suitable method of enrichment for processes in which coal is gasified under pressure, and also as the basis of pressure-gasification processes which use oil as the sole raw material.

Rapid Mixing

'The procedure followed has been to supply the oil to a bed of coke particles fluidised with a gas rich in hydrogen at the desired pressure, and to use the fluidised bed to control the temperatures developed by the exothermic hydrogenation reaction and to retain any deposited carbon and ash from the oil. Pilot-scale tests have shown the first requirement to be a rapid and thorough mixing of the oil and hydrogenating gas, and with oils, such as light distillate and gas oil, it is the only precaution to be observed: accordingly, these oils are vaporised and mixed with the hydrogenating gas before it enters the fluidised bed.'

'Heavier oils such as crude oil and fuel oil cannot be vaporised completely and, unless pretreated, they must be atomised directly into the bed, where it is then necessary to prevent agglomeration and caking and the paper describes a method, depending on the recirculation of the fluidised coke, that has proved satisfactory.

'Results show that high yields of gaseous hydrocarbons can be obtained by pressure hydrogenation. With light distillate, conversion was complete when producing gas of 580 B.Th.U. per cu.ft. at 32 atm., and when the calorific value was 863 B.Th.U. per cu.ft., there was only 3.0% of condensate. With gas oil, 82.1% was converted to gas, the remaining 17.9% being obtained as condensate. This 17.9%, however, included 11.8% as benzene and 3.9% as naphthalene. There was only 2.2% as higher hydrocarbons. No carbon was deposited from either light distillate or gas oil. The yield from crude oil was almost as high as from gas oil, with one test showing a conversion of 78.9% to gas with an additional 8.6% to benzene; 2.4% of the carbon in the oil was deposited. With heavy fuel oil, 68.5% was obtained as gas and 9.1% as benzene. Here, there was 4.2% of deposited carbon, but this was still less than half the Conradson carbon figure for the oil. These yields were obtained on a pilot plant, which restricted the pressure used for hydrogenation and the depth of the fluidised bed, but laboratory results indicate that from the heavier oils, there would be appreciably higher yields with deeper beds and higher pressures. Nevertheless, the yields already obtained are adequate for hydrogenation to be the basis of an oil-gasification process with an overall thermal efficiency of 75 to 80%, and the gas to be delivered under pressure for distribution. Used in connection with a pressure-gasification process for coal, oil hydrogenation would give the enrichment desired and, in comparison with the alternative method by catalytic methane synthesis, there would be a 30 to 50% greater output without the consumption of any more oxygen.

'Since the gas produced from these pressure processes is rich in hydrogen and low in carbon monoxide, it requires the addition of nitrogen, e.g., as air, to adjust its density and combustion characteristics. In itself, this brings the combustion characteristics under control, but it requires extra enrichment to reach town gas calorific values. Hydrogenation is able to provide this extra enrichment without appreciable loss of efficiency. It is expected that the gas will be low in organic sulphur compounds.

'Aliphatic hydrocarbons and hydrocarbon groups are readily hydrogenated and it was found that, when the conversion of an oil to gas was incomplete, it was only the parent aromatic hydrocarbons that survived. As a result, benzene and naphthalene could be separated easily from the condensate in a relatively high state of purity.

'During the tests, the available supply of hydrogenating gas limited the fluidising velocity to 0.4 ft. per second. With a fluidised bed of 11.25 in. diameter, the pilot plant then had a throughput of about 200,000 cu.ft. per day, and the corresponding throughput for a large plant of 10 ft. diameter would be 23 mill. cu.ft. per day. Since, however, the fluidising velocity could be, say 1 ft. per second, it would be possible for commercial hydrogenation units to have throughputs of more than 50 mill. cu.ft. per day.'

Mr. H. Moys, Chief Engineer, W.M.G.B., said: 'Dr. Dent's long interest in high pressure gasification is well-known and, after so much pioneering and missionary work, he must now have the feeling that the "promised land" is now in sight.

'Pressure operation seems to offer many advantages, among which are: (1) A cheaper source of both coal and oil can be employed, (2) a very good quality of gas, (3) if necessary, a low CO content and high purity, and (4) a greater output from any given site and, we sincerely hope, a much more attractive works and the cause of no nuisance to neighbours.' My own interest in the Lurgi plant has been maintained for nearly five years and the West Midlands Gas Board are seeking to overcome the planning obstacles for building a completely new Lurgi station. The chief drawback of the Lurgi plant is that, in spite of the use of oxygen, the C.V. of the coal gas, after purification and CO_2 removal, is still only 410 B.Th.U. per cu.ft. While Dr. Dent hopes to improve on this by working with a deeper fuel bed, the problem of enrichment in our early plants is fundamental, and after thinking deeply on the methods to be employed, the following present themselves:—
(1) Methane synthesis, (2) 1,000 B.Th.U. oil gas, (3) hydrogenation.

High Purity Needed

'Since catalysts are employed in methanisation the gas has to be of a high degree of purity, and so the Rectisol process using methanol at very low temperatures has been developed by the Lurgi Company for producing a gas of such high purity that it could be used for synthesis.

'On page 39 of the paper, however, the output is shown to be reduced when methanisation is used and this is in spite of Dr. Dent's constant endeavours to make the steam and oxygen in his experiments go further in the production of gas. While Dr. Dent's experiments with hydrogenation were still at the laboratory stage, we had looked into the possibility of enriching Lurgi gas with high B.Th.U. gas made by the Onia Gegi, Hall or Semet Solway processes. These plants operate at atmospheric pressure and we then have the problem of incorporating this rich gas with the purified Lurgi gas, presumably at high pressure. This was not an easy problem as condensation of hydrocarbons does occur on compression, but this was something which could be overcome and would enable a higher output to be obtained from the initial installation of the Lurgi plant before the development of the hydrogenation process.

'Hydrogenation does seem to offer the best of both worlds. Again referring to page 39, where Dr. Dent gives the various outputs that can be obtained by using various enrichers, I should be interested to know the efficiency of the CO conversion that he has assumed. This, of course, is a process that we have not used in the gas industry but I believe that great developments have taken place since the war.

'On page 35, Dr. Dent refers to the fact that hydrogenation would be more complete if the fluidised bed had been deeper and if higher pressures had been used. My reading of the paper suggests that he has already been working at 32 atmospheres, and I should be glad if he would tell me what will happen if the working pressure is reduced to that of the Lurgi plant, say, 22 atmospheres. Are the conversion efficiencies going to fall or can he improve them by increasing, within reason, the temperatures? Perhaps Dr. Dent could also indicate to me what will happen to the CO conversion unit if this again operates at Lurgi pressures. More gas compression should be avoided and we certainly cannot afford to have the Lurgi vessels designed for higher working pressures than at present.'

'The use of the Lurgi plant, a hydrogenation unit and a CO conversion unit are going to force us to use new techniques and the standards that we have in the past applied to our gasworks construction will have to be completely modified.

The shortage in supplies of gas oil for oil gasification plants of all kinds have led to experiments with heavy oil. This again is by no means satisfactory because of the types of tar formed, nor is it so easily available with the extra demand on supplies for space heating so I feel that, in the Midlands, the use of primary flash distillate would appear to be a solution, since the oil companies had, before the recent crisis, quantities of this material to offer to our industry. The price compared to other products was fair but, I think, we do need some incentive bonus to handle this material because of its low flash point. As a basis for the hydrogenation process in the Midlands and as an enrichment of the Lurgi gas, P.F.D. would seem to be quite reasonable. Does Dr. Dent feel that his researches have gone far enough for him to be satisfied that a hydrogenator to use P.F.D. could be designed now?

'Finally, what happens to the sulphur present in P.F.D. and in gas oil? Does it appear as sulphuretted hydrogen or is it converted to organic sulphur in the gas?'

Dr. M. Barash, Coal and By-Products Officer, W.M.G.B., said: 'If we were a purely scientific audience we would be overjoyed at this paper but, as gas engineers, we have to look further into the more mundane "bread and butter" factors, especially as the authors have made such a valiant attempt to translate their "experiments" into potential "commercial units of very high capacity." We are left very much at sea regarding the economic aspect of the process and the gas engineer searches in vain for his "cost of gas into holder".'

'Dr. Dent in his reply to the discussion at the Autumn Research Meeting of the Institution was apparently not ready for, and so, completely avoided, this issue but it is to be hoped that today he can give us at least some indication of the prospective capital costs and the production costs of hydrogenation gas.

Formidable Problems

'It may be even too early to expect this yet if the chemical engineering problems involved have not yet been worked out, since some of these problems appear to be proving quite formidable. It is a simple matter, on paper, to multiply diameters, pressures and other items on a pilot plant by numerical factors to arrive at the dimensions and expected outputs of a large-scale unit, but past experiences show that in such a translation the practical problems involved may multiply themselves by much larger factors. The disposal of waste products from the process at the laboratory scale or even at the pilot plant scale, may not appear to be a serious problem, but from the commercial unit (of 50 mill. cu.ft. per day) as envisaged by the authors, it could be a serious embarrassment.

'In this connection there are three items to consider, though all of them are associated with each other.

(*a*) *Deposited carbon.* The 1 mill. cu.ft. per day plant now being constructed will produce, according to figures in the text, about half a ton per day of deposited carbon, which is not easily handled or disposed of, but the large commercial unit would apparently involve the handling and disposal of 15 to 30 tons per day, depending upon whether crude oil (over 2% deposits) or heavy oil (over 4% deposits) were used).

(*b*) *Condensates.* Even after the recovery of the benzole and naphthalene there apparently remains for disposal as a seemingly unattractive waste product, in proportion of the initial feed stock, 2.2% from gas oil, 7% to 9% from crude oil and 12.3% from heavy fuel oil, or about 100 tons per day for heavy fuel oil from the 50 mill. cu.ft. per day unit.

(*c*) *Vitiated carrier* (fluidised bed). The fluidised carrier bed of coke particles (coke crushed to below $\frac{1}{6}$ in.), one of the main functions of which is 'to retain any deposited carbon and ash from the oil,' will become progressively vitiated by these retentions and will consequently require to be periodically or progressively renewed, and the spent material will have to be disposed of. There is no indication in the text (apart from the weights of individual batches used in the tests) of the magnitude of this disposal problem, but it would appear to be considerable.

'Could Dr. Dent also give some indication of the amount and degree of technical supervision which a large-scale unit of such a plant would need, or would such a plant lend itself effectively to automation?'

Genuine Discovery

Sir Henry Jones, President of the Institution of Gas Engineers, said: 'The Midland Section is to be congratulated on its enterprise in arranging for the presentation of this very valuable paper to a meeting of the Section. The paper records what I believe to be a genuine discovery as opposed to the development of a prosess based upon existing knowledge. Genuine new discoveries are not common even in these days. I believe that the processes described in this paper will find early application in gas manufacture, possibly in ways which it is difficult to foresee at the present time.'

Mr. F. H. Bate, Dudley, said: 'It is not possible to grasp all the implications of this work on the first hearing, but from a practical point of view there are several salient facts:—

(a) The low specific gravity of the gas produced, (b) the flexibility of calorific value, (c) the remarkably low sulphur content, and (d) the very high proportion of benzene and aromatics in the condensate.

'The gas seems ideal, and this should stimulate enquiry as to how we can bridge the gap between research and practice.

'There is always the capital cost of implementing research in the form of major plants, but is there not some way in which we can reap some of the fruits by a partial advance? All our production processes are conducted at approximately atmospheric pressures, but the minimum pressures given in the experiments are 25 atmospheres. Is it not possible to bridge the gap in our knowledge? I make this point because there appear to be some analogies between the use of oil in a water gas plant and the experiments described. In a water gas plant oil is "cracked" in an atmosphere rich in hydrogen at the right temperatures for the hydrogenation action. How much increase in pressure is required before the hydrogenation reactions commence? Again, considering the reactions for the oil gas plants, should we effect improvements by increasing the pressures within these vessels?

'Now that all the equipment is available could we not have some experiments at lower ranges of pressures. From these experiments it might be possible to deduce how much it would be necessary to increase pressures in existing plants, i.e., in both water gas and oil gas, before reaping some of the fruits of this research.

'In effect, I am pleading for closer co-operation between research and practice at a lower level than it is at present. I think we may have focused our attention too much on the conception of future gas making processes without considering whether any of the lessons of research could be applied immediately. I suggest there should be a joint body set up of production and research men to examine very carefully the possibilities of advances in modern production practices.'

Dr. L. A. Moignard, Midland Research Station: 'The whole investigation had at least one peculiar feature, namely, that it didn't start in the laboratory. Typically, work such as this starts on a small scale, when many questions can be settled before a pilot plant is designed, but it was realised at the

outset that when it was a question of hydrogenating crude and heavy oil, the physical and engineering problems of getting the oil into the reaction space in contact with hydrogen before it was thermally decomposed and coked could only be tackled on a pilot plant. There was still much scope for the laboratory work which forms the basis of the Appendix to the report.'

Dr. Moignard went on: 'As the report indicates more fully, the liquid condensate is of particular interest and economic importance. There is reason to think that most of the aromatic nuclei which it contained were present in the original oil as compounds with paraffinic or unsaturated side chains and that hydrogenation of the aliphatic compounds also present was accompanied by stripping these side chains off the aromatic nuclei which it contained were present in the original naphthalene. Only exceptionally was even so simple a derivative as toluene found; the stripping of the side chains was nearly always complete. On the other hand, aromatics can be synthesised; with high rates of oil supply more benzene was formed from light ends than can arise from such little amount of aromatics as is present in the oil. The whole intricate topic of aromatic hydrocarbon formation has been judged so interesting that a Gas Council research scholar has been invited to work on it here in Birmingham in the University Chemical Engineering Department under Professor Garner.

'It seems then that aliphatics are easy to hydrogenate and aromatics more difficult, and one might think that, whether by increasing the pressure or the time of contact, there is not much room for getting much more gaseous hydrocarbons and certainly what is formed must be at the expense of the aromatic condensate since, all through the series, very little carbon was deposited as such. Broadly, this is so; at 800°, raising the time of contact from 10 to 100 seconds raised the proportion of carbon in the oil gasified only by a few per cent. and at the longer time of contact doubling the pressure increased the figure only a little more.

'As the proportion of oily condensate formed falls, under increasingly severe hydrogenating conditions, it becomes richer in benzene, lighter in colour and so freer from complex compounds with a tendency to tar formation.

'These indications lead us to open the question of further treatment of the heavier compounds in the condensate oils, and one can choose as typical compounds for experimental purposes, naphthalene, fluorene and anthracene. If their further hydrogenation and decomposition could be controlled, theoretically 60% by weight of benzene from naphthalene, 94% from fluorene and 87% from anthracene might be obtained. So far, we have worked with naphthalene and fluorene only, and at pressures up to 100 atm.

Yield Below Expectation

'From our first experiments with naphthalene, although one can get respectable yields of benzene, for instance 31% at 50 atm. and 850°C., the yields fall far short of the theoretical. With naphthalene, furthermore, one has to steer carefully between low reactivity on the one hand at a low temperature and the extensive carbon deposition which appears at higher temperatures.

'From fluorene, with its structure of two benzene rings linked both by a direct carbon-carbon bond and by a second link through a "CH_2" group, one would expect that, besides benzene, the intermediates diphenyl and diphenyl methane would be formed. Again we get about half the theoretical yield of benzene and there are indications that the reaction is more complicated than one might expect. We may have opened up here a complicated and potentially very fruitful topic of research, the object of which must be to understand these hydrogenation reactions with a view to controlling them and favouring those which lead to benzene. We have done almost nothing with catalysts so far and it is not beyond possibility that catalytic hydrogenation of the higher aromatics might be as effective as catalytic oxidation, e.g., of naphthalene is in channelling the reaction in a chosen direction.

'The experiments we have in mind need not be long ones and we have developed a simpler type of coke recirculation system which we hope will run for the required period without trouble. In it, an inner sleeve inside an outer tube forms the riser and the annulus is the downcomer. The oil will be injected together with most of the hydrogen at the base, and the circulating system will be surmounted by the reactor proper.

'The whole vessel will be 14 ft. long, the circulating portion 6 ft. and the reactor 8 ft.; the latter will accommodate a 5 in. diameter fluidised bed 5 ft. deep. Oil supply rates will be 1.5 gal. per hour at 30 atm. and 2.5 gal. at 50 atm., outlet gas rates being 550 and 900 cu.ft. per hour respectively. This unit is now being built.'

Mr. W. R. Branson, Deputy Chairman, W.M.G.B., pointed out that, while the work on high pressure gasification was at present necessarily directed to the production of a gas interchangeable with normal town's gas with a similar calorific value, such work would in the future make possible a reduction in distribution costs, and this should not be lost sight of.

Referring to the staffing of commercial units operating high pressure processes, he said that he thought that staff with a different type of training from that normally met in the gas industry would be needed, but that the cost of such staff would not be more, and might well be less because of the high unit output obtainable from high pressure plant.

Dr. E. Johnston, Leicester, asked:

1. Has a catalyst been tried in order to reduce the temperature and/or pressure of the reaction?
2. How is the bed supported when the unit is idle and starting up?
3. Does the fluidising behaviour of the coke or the time of residence of the reactants govern the throughput?
4. Would the size of coke reach equilibrium, deposition of carbon on the one hand and attrition on the other?
5. In Series 5, p. 46, is not the tube of $\frac{1}{16}$ in. diameter very small for fluidisation?
6. In view of the results in Table 11, p. 48, would there really be a need for a fluid bed of coke for gas oil and lighter distillates?
7. If the aim is to produce a gas with a final calorific value of 450 to 500 B.Th.U. per cu.ft. from oil only, that is from the processes shown in Fig. 2, then there would appear to be no case for using crude oil. Similar yields are obtained and crude oil is likely to be more expensive and will require more stringent storage facilities because of its lower flash point.
8. What is the thermal efficiency of hydrogen production?
9. What are the merits of process 2(a) compared with catalytic oil gasification plants of the Segas and Onio-Gegi type? Both these processes can produce about 1.25 therms of gas per gal. of heavy fuel oil which approximates to the yields of gas calculated from tables 3 and 4. They operated at low pressure and do not require a supply of hydrogen, which inevitably requires additional capital expenditure and may reduce the overall thermal yield of gas.
10. Will this work be extended to the use of coal?

Dr. F. C. Wood, Midlands Research Station, said: 'In order to extend the range of operating conditions and, at the same time to enable experience to be gained of the operation of the process over considerably longer periods than were obtainable at Poole, a larger pilot plant has been designed and is now being installed at the Midlands Research Station. The capacity of this semi-scale plant is intended to be 1 mill. cu.ft. per day of product gas, of calorific values ranging up to 1,000 B.Th.U. per cu. ft. This plant, it is hoped, will be ready for operation by September of this year. In it the methane reforming and CO conversion units are small-scale commercial plants, and it is not to be anticipated that, as such, they will have a high level of performance from the viewpoint of individual or overall high thermal efficiency, but in the present investigation their function is solely to provide a hydrogen-rich gas in a convenient easily operated, and reliable manner. This combination of units also has the great merit of flexibility, in that the composition of the hydrogenating gas can be varied within wider limits, for example, to simulate a Lurgi-type gas, if required.

Overall Commercial Process

'At the same time we realise that this could be the basis of an overall commercial process for towns gas production from oil, and laboratory investigations have been and are proceeding, at the Midlands Research Station, into means of improving the performance of each unit. Our intention then is first, to elucidate the outstanding problem of operation of the oil hydrogenation process and then to concentrate upon bringing the performance of the ancillary units up to the high level of the hydrogenation plant. The relative rôles of the hydrogenator and its ancillaries will thus be reversed. The

former may be used merely to produce a hydrocarbon-rich gas for investigating and improving the performance of each individual unit.

'Finally, I would like to mention that we are carrying out studies of the distribution of the reactants in large scale atmospheric pressure models, of sizes of up to a 5 ft. diameter bed (that is, equivalent to a commercial unit of gas output of six to 25 mill. cu.ft. of gas per day, dependent upon the operating pressure and gas velocity). One such model is shown in Fig. 12 of the report. The knowledge which we gain, in this manner, will be invaluable in the design of any subsequent large-scale commercial hydrogenation unit.'

Dr. Hebden, in a written reply, said:

'Mr. Moys' remarks show the important relationship between this work on oil hydrogenation and the Lurgi plant which the West Midlands Gas Board proposed to build in their area. He has also indicated that conditions in the Midlands suggest primary flash distillate (light distillate) as being, economically, the most suitable raw material for enrichment. From the results and experience so far obtained it would be possible now to design a full scale reactor for the enrichment of 30 mill. cu.ft. per day of Lurgi gas. Before closing down the pilot plant at Poole, however, test will be carried out on light distillate using a hydrogen partial pressure of 10 atm. to confirm the specific application of the process to the enrichment of Lurgi gas. We have no doubt that a satisfactory performance will be achieved in this lower pressure range.

Influence of Pressure

'Thermodynamically pressure has no influence on the CO conversion reaction, so that as far as the degree of conversion at any given temperature and steam addition is concerned, it does not matter whether the process is operated at atmospheric or 100 atm. pressure. The main measure of efficiency of CO conversion is the degree of steam decomposition obtained and this is dependent, at any given steam addition, on the temperature at which the catalyst is operated; the lower the temperature the greater the steam decomposition. In the table on page 39 it was assumed that the CO in the gas would be reduced in the conversion stage from 22.6% to 5%. Assuming that equilibrium can be reached in the exit gases at 400°C., 35 to 40% of the steam would be decomposed.

'It may be of interest to mention that the incorporation of a CO conversion stage on a Lurgi plant using oil hydrogenation for enrichment could be used not only to increase the plant output, but also to increase the overall decomposition of gasification steam. For example, if the plant was so arranged that the undecomposed steam leaving the gasifier was not condensed until after the conversion stage, the steam decomposition would be raised from 37% to 47%. Investigations are being pursued at Solihull with the intention of developing the Lurgi process along these lines.

'In reply to Mr. Moys' final question, it can be taken that the sulphur in the original oil will appear almost entirely as hydrogen sulphide in the gas. The amount of organic sulphur present will mainly depend on the CO concentration in the hydrogenating gas and the extent to which this leads to the formation of COS. With a low CO concentration it is unlikely that the organic sulphur content will exceed 5 grs. per 100 cu.ft.

'Dr. Barash can be assured that by-product disposal is not going to present any serious problems. There will always be an outlet for the residual condensate and deposited carbon for raising power and process steam. In any case, in the system shown in Fig. 2(a), the residual condensate can all be returned to the oil gasifiers, while in system 2(b) at least 60% of it will be required to fire the methane reformer. Dr. Barash is not strictly correct in saying that the fluidised bed is "vitiated" by the retention of deposited carbon and ash. The fluidised bed is in fact being constantly renewed by the deposition of carbon, the surplus being withdrawn along with the ash from the oil as it accumulates. The main point here, as mentioned by Dr. Johnston, is the growth of the particles as a result of carbon being deposited upon them. Tests have not yet been carried out which were of sufficient duration to decide positively whether or not a stage of equilibrium is attained between deposition on the one hand and attrition on the other.

'We were glad to hear Mr. Bate's constructive remarks and his enthusiastic appreciation of what our researches are trying to achieve. Unfortunately there are two major factors which prevent the application of pressure to existing processes. First, the pressure would have to be raised at least five or ten fold to reap any worthwhile benefit and secondly, existing processes are cyclic and pressure would bring in its train problems of purging, compression, etc.

'Dr. Johnston asked a number of interesting questions, some of which have already been answered above. A fluidised bed, contrary to popular belief, is a notoriously bad contacting agent and there is ample scope for improvement here. In our case, however, in the absence of catalysts, contact between vapour and solid was of secondary importance. The primary function of the fluidised bed, as stated in the report, was to maintain a uniform temperature throughout the reaction space, to receive any ash in the oil and to support hydrocarbon constituents which do not vaporise and any carbon which does not hydrogenate. Thus, the fluidising properties only determine throughput as far as they govern the velocity and hence the rate at which the reactants are passed through the bed. Depending on the size of the material used and the type of baffles employed, the velocity under the prevailing conditions of pressure and temperature may vary between 0.10 and 1.0 ft. per second. The depth of the bed is then chosen to give the desired time of contact.

'On the pilot plant there were means of isolating the downcomer from the upriser and simple non-return valves were incorporated in the various gas supply lines. With these facilities it was possible to interrupt gas flow and restart at will. It is true that a tube $\frac{1}{16}$ in. diameter is rather small for fluidisation but the experiments referred to were carried out primarily to obtain a comparison with similar ones conducted in 'empty' tubes.

'Whereas the hydrogenation reaction will, as demonstrated with distillate oils in the laboratory, proceed satisfactorily to completion in the absence of a contact material, on the large scale a fluidised bed must be used as already mentioned to maintain a uniform temperature in the reaction space. In the absence of such a medium, local high temperatures would develop leading to the formation of soot and the production of the higher aromatic compounds with a consequent reduction in gas yields. It can be said that the choice of oil for any given process arrangement will be determined more by its local availability than by weighing the merits of one oil against those of another. One cannot give a direct answer to the question on the efficiency of hydrogen production since so much depends on how much capital is invested in heat recovery. As an indication, however, the approximate figures would be 60% for processes involving the gasification of oil with oxygen and say 75% for the process involving methane reformation.

Merits of System

'In comparison with existing processes operating at atmospheric pressure, the merits, for example, of the system shown in Fig. 2(b) are as follows:—

(a) The heat losses are low and the overall thermal efficiency could be greater than 80%.
(b) by products are recoverable from all the oil supplied, benzene separating dry during cooling and sulphur being obtained as H_2S in high concentration.
(c) the decomposition of steam, the conversion of carbon monoxide and the removal of CO_2 occur on a purified gas stream.
(d) there is no production of contaminated liquor.
(e) the combustion characteristics are under control and the hydrocarbons are saturated and stable. The gas contains no gum and is low in carbon monoxide and sulphur compounds.
(f) the costs should be low due to the feasibility of building units of large capacity, e.g., 50 mill. cu.ft. per day each.
(g) finally, the gas is available under pressure and could readily be transmitted over long distances.

'This work will certainly be extended to the use of coal. In a way the development of the oil process has set the standard for the development of the coal process and the preliminary investigations show promise of this being maintained.

'The remarks of Sir Henry Jones and Mr. Branson call for no reply apart from thanking them along with other speakers for their contributions to the discussion. The members of the team who carried out this work would like to express to the Chairman and members of the Midland Section their appreciation of the opportunity which has been given to them of presenting this report for discussion a second time.'

The Major gas-operated drying cabinet.

- **Drying cabinet**
- **Cabinet/kitchenette**
- **Grill/boiling burner**
- **Director portable**
- **Century convector**
- **Landmark fire**
- **Double De Luxe**
- **Super Century**
- **New World Cadet**

The Angus-Archer Kitchenette, complete with Junior General gas cooker.

These New Gas Appliances Make Every Home Ideal

THE gas engineer visiting the Ideal Home Exhibition will find several new domestic gas appliances being offered by the manufacturers designed to make life more pleasant in the modern—or should we say contemporary—home.

Top left is pictured an appliance which is attracting a lot of interest. It is the Major gas drying cabinet, which will fit into a kitchen where there are unit fitments.

The interior is fitted with six plastic rails for clothes, and is equal to a 10 ft. clothes line. Finished in cream or white enamel, or in colour to order, a stainless steel working top is available at extra cost. Made by the Victor Manufacturing Co. (Greengates), Ltd., the approximate price is £29.

* *

Top right is the handsome Angus-Archer Kitchenette, which opens to reveal a fully equipped small kitchen, complete with Junior General gas cooker.

Beneath the cooker is a 10-in. folding table flap and drawer for linen and cutlery. The lower part forms a spacious storage cupboard which is ventilated at both ends. A special safety device prevents the doors being closed until the gas is off—ensuring complete safety. The exterior is finished in natural wood, or a range of finishes. Price 42 guineas.

* *

The Cannon Foldaway visual grill, an independent wall unit, is now to be marketed as it is illustrated below left, with a boiling burner. This combined grill and boiling burner unit can be fitted on the wall in any convenient position and is ideal for small flats and bed-sitters.

When not in use the boiling burner is completely concealed and the grill folds away, thus forming an attractive porcelain enamelled cabinet.

The wall grill unit is finished in white or cream and will be available shortly from all gas showrooms. Price £15 15s. or £12 12s. for the grill only. An optional extra at 15s. is a removable 6-position plate-rack.

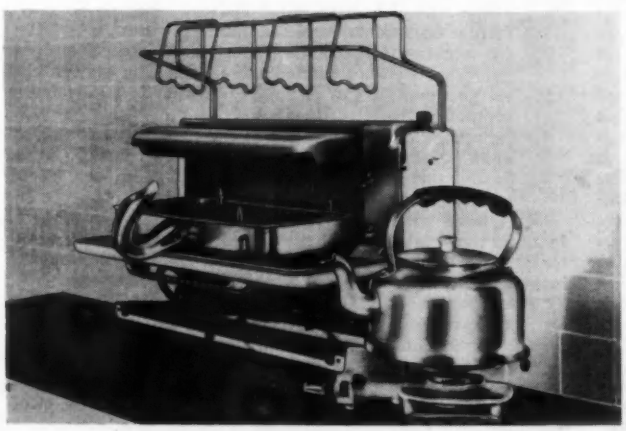
* *

On the next page the Bratt Colbran Director is seen to be a gracefully shaped portable gas fire with a special safety feature. If accidentally overturned, the fire is cut down immediately to a tiny pilot flame, which minimises any risk of fire. On return to its normal position the fire automatically lights up again. The Portcullis radiant of high efficiency is set within a satin-finish chromium plated reflector with polished outer edge. A safety dress guard encloses the radiant. Gas consumption is 12 cu.ft. an hour. Approximate price £6 18s. 4d.

* *

The unusual styling of the Main Century convector makes it a focal point in any room. A radiant panel, with integral guard, is set at the bottom of the fire; above it is a large expanded metal grille through which convected warm air is circulated into the room. A practical feature is the convenient position of the automatic lighter and heat control knob, which is set at the top of the gently curved outer casing.

The heat control has four marked positions from 'Full' to 'Very Low' and there is a continuously variable control between each marked position. With its exceptional efficiency 'Full On' heat is only required for initial warming up. Price about £27 12s. 5d.



Cannon grill with boiling burner.

A new radiant-convector gas fire of attractive design, which has automatic lighting incorporating a flame failure device, has been produced by Stoves Ltd. The radiants are set in a curve within polished chromium panels, giving a distinctive appearance to the fire. In addition to the radiant heat, warm air is convected into the room through louvres at the top of the appliance. The Landmark, as it is called, will cost £19 17s. 6d.

* *

The new Cannon Double De Luxe is an addition to the range of appliances which includes the A125 and A130 cookers.

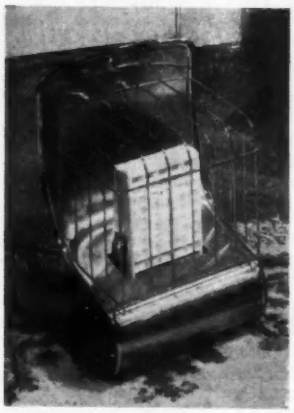
The Double De Luxe comprises two ovens, two warming drawers, and a continuous 6-burner hotplate. One-half of the splashplate behind the cooker incorporates a utensil shelf, built-in cook-timer and hotplate floodlight. The other half embodies the Foldaway high-level grill. The Double De Luxe can also be supplied with a twin grill, the second grill being mounted above the splashplate.

The large continuous hotplate provides four high-speed and two medium boiling burners, all of which are ignited by automatic press button ignition. Supplied with this cooker is the Cannon Rotoroast, a rotary spit that clips on to the oven meat tin.

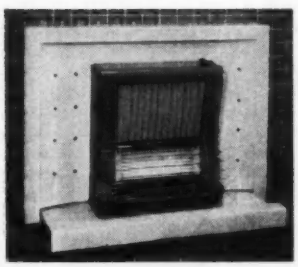
A built-in cook-timer can be set for periods of up to five hours. The hotplate floodlight is built into the splashplate. A plate rack to accommodate six plates can be fitted, and a torch is provided on the right-hand side of the cooker for the ovens and grill.

Finished in white porcelain enamel—or cream enamel to order—it will be available shortly from all gas showrooms, price £129 3s. for the standard model, or £139 13s. with the twin grill.

Cannon's Double De Luxe cooker.



Bratt Colbran Director portable fire.



The Main Century convector.

* *

The new 122 Super Century gas cooker, by R. & A. Main Ltd., incorporates all the popular features of the successful Century plus a high-level grill and a re-designed hotplate incorporating new type hob and glide-over pan supports designed to facilitate cleaning. New pattern taps allowing flexibility of control of the four high-efficiency boiling burners have also been fitted.

The roomy oven is fitted with a drop-down door. The single burner, situated at the rear, is fitted with a flash ignition tube.

The cooker is finished in glass-hard vitreous enamel with plastic fittings and is available in a number of colour combinations. List price: £37 2s. 9d.

The Main Super Century cooker.

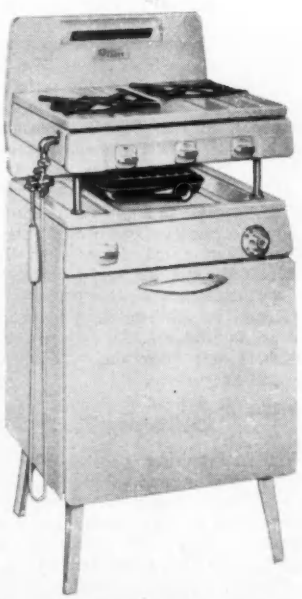
* *

Radiation's New World Cadet cooker is intended for small homes where space is limited. It is of neat contemporary style with smooth, slightly bowed panels.

Normally catering for two or three people, a whole meal for four or more adults can be cooked in the oven.

Radiation stain-resisting vitreous enamels are used throughout, and the cooker is available in cream or white exterior finish. Price with folding plate rack: £23 9s. 0d.; with splashplate only, £21 18s. 0d.

Stoves' Landmark fire.



Radiation's New World Cadet.

WESTERN—WALES AND MON. JUNIORS' JOINT MEETING

Appropriate Jubilee Year Function

THE British Junior Gas Association's Joint Council celebrate their Jubilee this year. Most appropriately, the Western Junior Gas Association and the Wales and Mon. Juniors decided to hold a joint meeting last Saturday, and among those present was Sir Henry Jones, President of the Institution of Gas Engineers.

Members and guests had the choice of inspecting three different parts of the Stapleton Road works of the South Western Gas Board, Bristol. They could see the new carbonising plant; or the new 6 mill. cu.ft. all-welded gasholder and compressing plant; or the new purification plant, which comprises a wet purification plant installed by W. C. Holmes & Co., Ltd., and a Gastechnik plant made by Robert Dempster & Sons Ltd.

Largest of its kind in the country, the liquid purification plant purifies gas to gas examiners' standards, and is capable of dealing with a total make of 12 mill. cu.ft. a day. Maintenance is most important, and a Gastechnik plant has been installed—but not yet commissioned—to allow major maintenance work to be carried out and to provide for 'catch-boxes.'

Purifying Pellets

In the Gastechnik plant, the gas is divided up into three streams, each passing through two towers where it is filled with purifying material in the form of pellets.

Material is extracted from the base of the second tower and transferred to the first as spent pellets are extracted. The second tower is charged with fresh pellets.

Sulphur Extracted

It is not possible to work up a sulphur content of more than about 35% in the spent pellets. Instead of the pellets being sold to sulphuric acid manufacturers, therefore, the sulphur is extracted and can be used for the manufacture of pure sulphur. The pellets are used again.

The chief advantage of this system is the low capital cost and small amount of labour necessary. The need to use these purifiers as catch boxes has largely diminished since the liquid purifiers have shown themselves capable of reducing the hydrogen sulphide content in the crude gas to as low as .15 parts per million, which is well below the requirements of the gas examiner.

Carbonising Plant

The carbonising plant, installed by West's Gas Improvement Co., Ltd., is housed in an attractively designed brick building, with large windows and ample working space. The all-welded holder was built by Oxley Engineering Co., Ltd. As stated, it has a capacity of 6 mill. cu.ft. and has four lifts with a reinforced concrete tank.

Two hundred and fifty people attended a lunch given at the Grand Hotel, Bristol. Mr. C. H. Chester, Chairman of the South Western Gas Board, presided.

Assistance in Education

Referring to the Jubilee Year of the Joint Council, Dr. Arthur Marsden, who welcomed the guests, said the Council's most important function was the assistance it gave to the education of the young man entering the industry. Mr. E. M. Edwards, Member of the Wales Gas Board, replying, said he supported the opinions of Dr. Marsden on this subject.

At the meeting that followed, Mr. J. B. Taylor, President of the Western Juniors, presided. He spoke of the founding of the Joint Council in 1907 as an 'epoch-making event in the history of the junior gas associations.' They had become of national importance instead of remaining isolated and without influence over the technical advances in the industry or its members.

Others who addressed the meeting were Mr. J. K. Lord, Senior Vice-President of the Manchester Juniors, and Mr. J. C. Hogg, Bournemouth and Mr. James Carr, Deputy-Chairman of the South Western Gas Board, both past-presidents of the Manchester Juniors.

The President then presented Sir Henry Jones, in his capacity as Chairman of the Management Committee of the Benevolent Fund of the Institution, with a cheque representing a special donation from the Western Juniors. After Dr. Braunholtz, Secretary of the Institution and Honorary Secretary of the Benevolent Fund explained how the Fund was helping past members and their dependents in need, Sir Henry Jones gave an address entitled 'Clean Air and the Gas Industry.'

Mr. H. Partington, with Mr. T. Nicklin, President of the Manchester District Association of Gas Engineers at the Liverpool works of the English Electric Co., Ltd., on an Association visit recently. They are inspecting washing machines.

Effort by Gas Industry Could Speed Clean Air, Says Sir Henry Jones

IN his address to the Bristol meeting, Sir Henry Jones said much wider acceptance of the conception of clean air than had so far been achieved could be won by the gas industry if it would direct sufficient effort toward promoting gas sales, improving the quality of coke and facilitating its purchase through the distributive trade, and seeing that architects, housing authorities, and the public generally, were constantly reminded of the benefits of gas and coke.

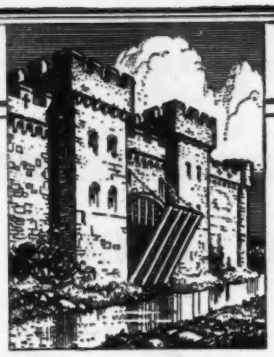
Earlier, Sir Henry had said the presence on the Statute Book of the Clean Air Act showed that the Government was aware of the appalling cost of dirty air and was determined to reduce it.

The speed-up of the atomic energy programme might give the impression that clean air was on the way regardless of existing fuel industries, but the high capital cost of nuclear power stations and the low thermal efficiency of reactors made it uneconomic to use electricity from this source for domestic heating during peak load times. Existing fuels such as gas and coke, would, therefore, be widely used for many years to come.

Having smokeless fuels to sell, the gas industry must encourage the creation of smoke control areas.

If about one-third of the 19 mill. tons of bituminous coal burned in 'black' areas, should be replaced in five years the industry would need the equivalent of 6.3 mill. tons of coal. About .6 mill. tons would be replaced by gas, and allow of an equal quantity by electricity, leaving 5.1 mill. tons to be replaced by solid smokeless fuel which would be equivalent to about 4 mill. tons of coke or other solid smokeless fuel. By a really vigorous effort the amount of coal to be replaced by gas could be increased.

The convector gas fire and the balanced flue space heater were both excellent weapons with which to attack the space heating market, especially in offices. For the open fire a coke grate with or without back boiler was the answer provided that a gas ignition burner was fitted.



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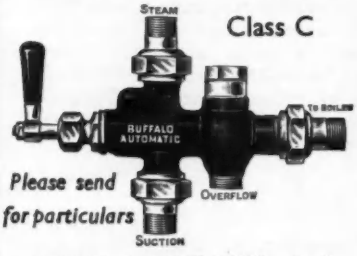

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NORTH THAMES GAS BOARD

CHEMISTS AND PHYSICISTS holding University degrees are required in the Laboratories at Watson House, Fulham, S.W.6, to undertake research work on the utilisation and design of domestic and industrial gas and coke appliances, particularly on cookers, water heaters, gas and coke fires, refrigerators, and industrial apparatus.

The Laboratories have recently been modernised and extended and are responsible for research work for the Gas Industry throughout the country.

The appointments will be permanent and pensionable, and the starting salary will be within the range of £680-£900 per annum, according to age, qualifications and experience.

Applications should be sent to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, W.8, quoting reference 666/280 to reach him within ten days of the appearance of this advertisement.

WALES GAS BOARD

SENIOR INDUSTRIAL GAS ENGINEER, EASTERN SECTION

APPLICATIONS are invited for a SENIOR INDUSTRIAL GAS ENGINEER, Eastern Section, within the salary range of the Senior Officer's Grade 'B' (£1,105-£1,265). Applicants should have had a wide experience in the application of gas for industrial purposes and experience in the design of construction and installation of industrial and commercial equipment.

Qualifications in fuel technology or any related subjects would be an advantage. Applicants should also have passed the Associated Membership Examination of the Institution of Gas Engineers.

The position is pensionable, and the successful applicant will be required to pass a medical examination.

Applications, stating age, education, qualifications and experience, together with the names of two referees should be addressed to the undersigned not later than April 6, 1957.

C. B. MAWER,
Secretary

2, Windsor Place,
Cardiff.

WALES GAS BOARD

WREXHAM UNDERTAKING
APPOINTMENT OF SENIOR TECHNICAL ASSISTANT—DISTRIBUTION

APPLICATIONS are invited from suitably qualified persons for the above appointment for which the salary will be within the range of A.P.T. 7/8 'A' (£670/£790 per annum) commencing at a figure commensurate with qualifications and experience.

Applicants should be experienced in the High/Low Pressure Gas Distribution Practice, including mainlaying and planning, also in controlling labour and the supervision of work being carried out by Contractors

The position is pensionable. The successful applicant may be required to pass a medical examination.

Applications stating age, experience, qualifications and particulars of training, together with the names of two referees, should be received by the undersigned not later than April 6, 1957.

J. F. LLOYD,
Engineer and Manager.

Gas Offices,
23, Salop Road,
Wrexham.

JUNIOR MALE ACCOUNTANT required by EAST MIDLANDS GAS BOARD (Leicester and Northants Division). The post is suitable for an advanced student interested in financial and management accounting and statistics. Applicants should be sufficiently adaptable, with training, to apply theory to practice and should also be willing to undertake necessary routine tasks as required. A modern punched card system is in course of installation.

The appointment will be made, initially, within the salary range £445-£690 per annum at a commencing salary commensurate with age and qualifications, but there will be opportunities for further progression for the right man.

The position is pensionable and the successful candidate will be required to pass a medical examination.

Applications stating age, and giving full details of education, qualifications and experience, together with the names of two referees, should be addressed to reach Divisional General Manager, E.M.G.B., Millstone Lane, Leicester, not later than April 15, 1957.

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
DIVISIONAL STORES AND PURCHASING OFFICER

APPLICATIONS are invited for the position of DIVISIONAL STORES AND PURCHASING OFFICER, to be based on Sheffield.

The successful applicant will be responsible for the implementation of the Board's policy on Stores and Purchasing Control throughout the Division, and should have considerable experience of the organisation and operational control of stores and stores systems. Some knowledge of punched card systems of stores recording would be an advantage.

The salary will be within the range of £1,225/£1,425 per annum (Senior Officers' Scale 'C').

The post is pensionable, and the successful applicant will be required to pass a medical examination.

Applications stating age, education, and qualifications, together with the names and addresses of two referees should be addressed to reach the undersigned not later than April 20, 1957.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road,
Leicester.
March 22, 1957.

EDUCATIONAL

THE GAS COUNCIL

RESEARCH SCHOLARSHIPS

THE Gas Council invites applications for five Research Scholarships from graduates or prospective graduates in physics, chemistry or engineering at British Universities. The scholarships will be awarded for a period of three years from September 1, 1957, and the Universities in which they will be tenable are as follows:—

University of Oxford: Departments of Chemistry.

University of Cambridge: Department of Chemical Engineering.

University of London: Department of Chemical Engineering at either the Imperial College of Science and Technology or University College.

University of Birmingham: Department of Chemical Engineering.

University of Glasgow: Department of Chemistry.

The subject proposed for research must afford scope for original work and be of a character approved by the Research Committee of the Gas Council which is interested in problems related to the manufacture, distribution or use of gas. Each scholarship will carry an allowance at the rate of £400 a year together with the payment of University and College fees.

Particulars and application forms may be obtained from the Secretary, the Gas Council, 1, Grosvenor Place, London, S.W.1, or from the Head of any one of the University Departments named above. Applications should be submitted on or before April 20, 1957, to the Secretary, the Gas Council, or, if the candidate is a student in one of the University Departments named above, to the Head of that Department.

March 18, 1957.

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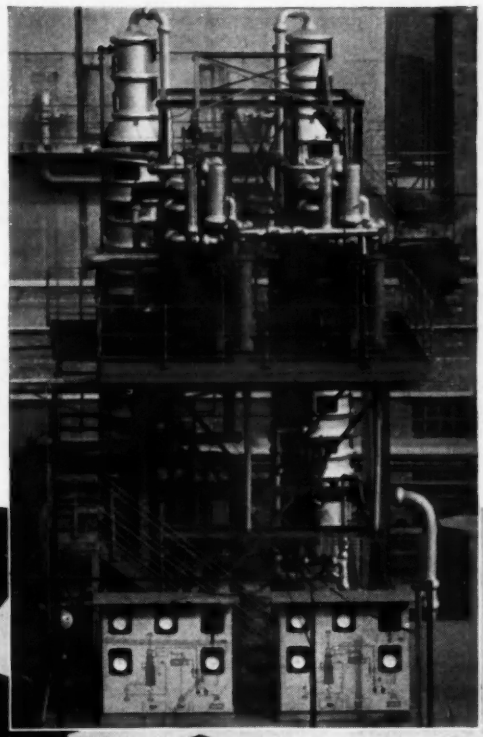

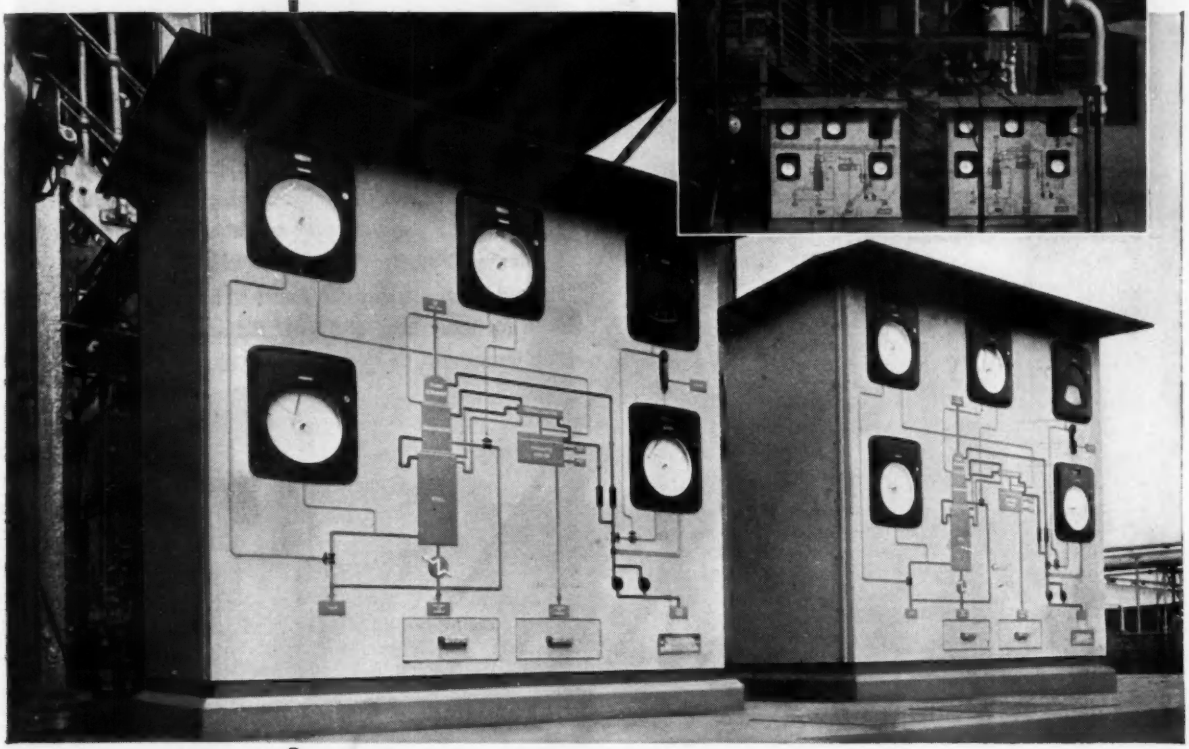

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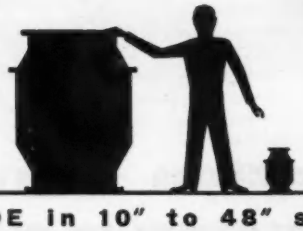

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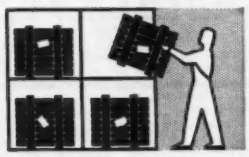

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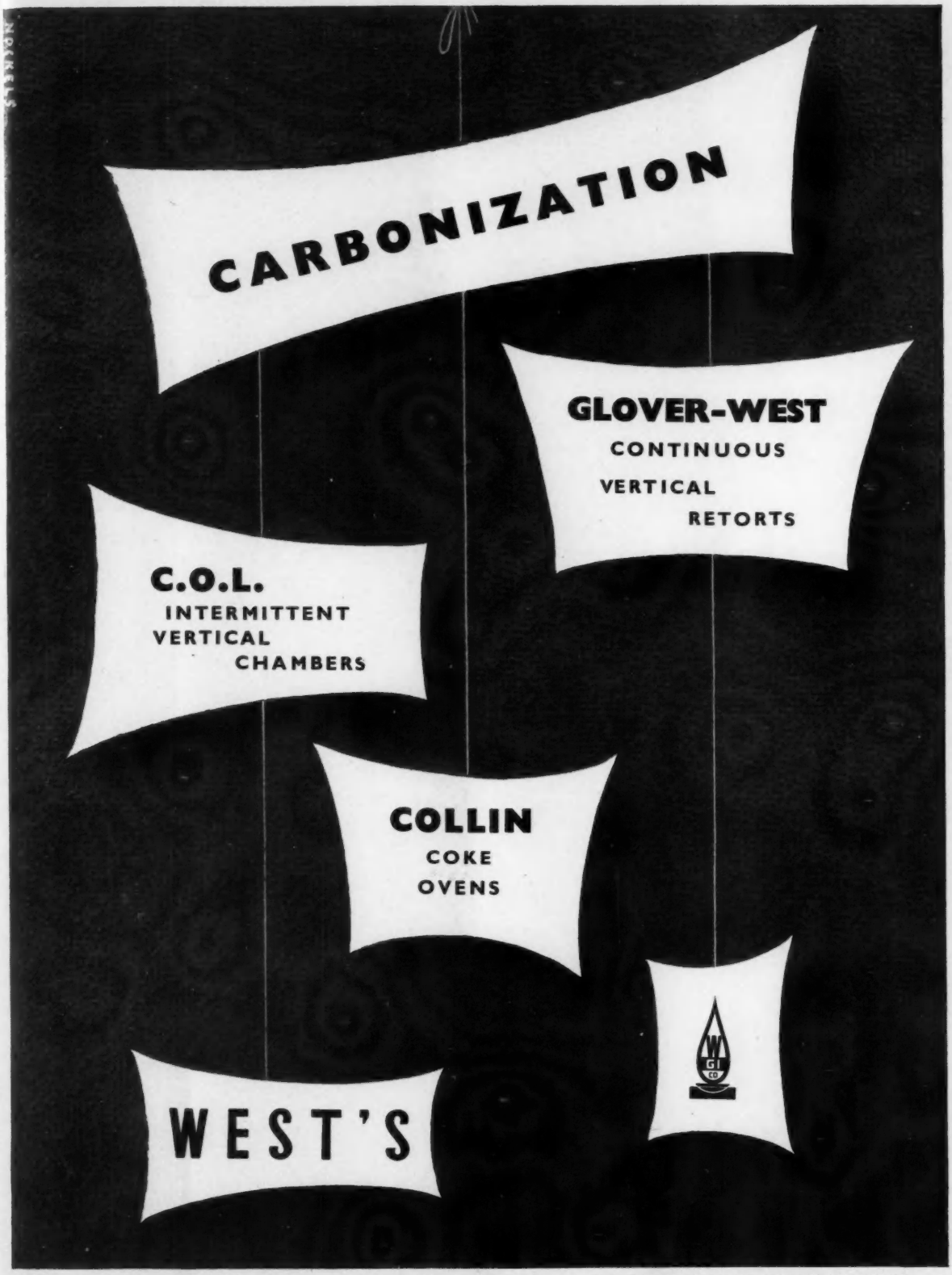

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